IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Serial No.	:	**09/665,303**
Filed	:	September 19, 2000
Applicant	:	John T. Santini, Jr., et al.
Title	:	Microchip Drug Delivery Devices
TC/AU	:	3763
Examiner	:	A.T. Nguyen
Docket No.	:	17648-0014
Customer No.	:	29052

DECLARATION UNDER 37 C.F.R. § 1.132

Mail Stop RCE
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

I, Robert S. Langer, hereby declare that:

1. I am an inventor of the above-identified patent application. I am the Kenneth J. Germeshausen Professor of Chemical and Biomedical Engineering at the Massachusetts Institute of Technology. A copy of my Curriculum Vitae is attached hereto.

2. I have over 500 issued or pending patents worldwide, many of which have been licensed or sublicensed to some 100 pharmaceutical, chemical, biotechnology, and medical device companies. I have over 30 years experience working in the fields of biotechnology and materials science, with an emphasis on drug delivery.

3. I have reviewed the Office Action mailed July 29, 2003, in connection with the present patent application. I also have reviewed U.S. Patent No. 6,114,658 to Roth et al. (hereinafter "the Roth patent") which is the English-language equivalent of the sole prior art

reference (WO 97/34697) relied upon by the Examiner for the rejections listed in the Office Action.

4. The Office Action mischaracterizes both the knowledge of one of ordinary skill in the art and the teachings of the Roth patent. The Office Action alleges "it is well-known to implant such a drug-carrying microsystem into a patient." (page 2, second paragraph). This is incorrect. One of ordinary skill in the art at the time of our invention would not have considered implanting the microsystem of Roth into a patient. Prior to the publication of our priority applications, nothing in the prior art would have suggested an implantable microchip device packaged for implantation into a patient for the controlled release of drug molecules, wherein the device comprises multiple reservoirs containing drug molecules, releasable from the device by diffusion through or upon disintegration of reservoir caps.

5. The Office Action also mistakenly contends that "[p]harmaceuticals are, by their very nature, intended to be administered to the body, and thus *are only encapsulated in miniaturized devices for one reason, being placed in the body*." (Page 7, third paragraph, emphasis added). On the contrary, a variety of storage and testing containment devices are never intended for implantation into a body.[1] A pharmaceutical compound can be "encapsulated" for a variety of reasons and in a variety of types and sizes of vessels over its useful life as it is

[1] In fact, the background of the Roth patent lists DE 3919042. The abstract of this patent describes

> micromechanical structures with reservoirs used to test substances for possible changes in physical and/or chemical properties. ... The structure comprises a block and a cover.... The block has a number of depressions of particular size shape, distribution, etc., and the cover has elevations which match these exactly so as to provide a hermetic closure...These structures are used for evaluation and documentation in biotechnology, genetic engineering, cell or immune research, or for other medical ... research. They allow dangerous substances to be stored and handled (for testing, etc.) safely, and provide simple process control and evaluation of tests on very small amounts of sample.

manufactured, tested, packaged for bulk transport and storage, packaged in unit dosage forms, and finally readied for administration. Thus, pharmaceuticals are not encapsulated in microsystem devices only for placement in the body.

6. The Roth patent discloses that it is desirable to encapsulate sensitive materials, such as chemical indicator materials, catalysts, and pharmaceuticals (col. 1, lines 9-10), and that conventional methods for encapsulating such sensitive materials include "encapsulation of the substance in a glass bulb, plastic foils or similar packings" (col. 1, lines 20-22). One of ordinary skill in the art would have understood that a pharmaceutical could be encapsulated or packaged using devices and materials *unsuitable* for implantation. Accordingly, one of ordinary skill in the art would understand Roth as disclosing the encapsulation of a pharmaceutical into a miniaturized device only for the purpose of storage and *in vitro* testing of small samples of a potential pharmaceutical compound, such as in a drug discovery screening process.

7. The Office Action also erroneously concluded that "whether Roth is merely testing the device or not, *one of ordinary skill would have found it obvious to implant the encapsulated drug device*." (Page 7, third paragraph, emphasis added). This is not accurate. The Roth patent does not teach or suggest to one of ordinary skill in the art that they could implant into a patient the encapsulation devices disclosed in the Roth patent. The Roth patent also fails to provide any motivation to one of ordinary skill in the art to adapt or package the encapsulation devices for implantation and use *in vivo*.

8. The Roth patent failed to provide to one of ordinary skill at the time of the present invention any motivation to modify the devices disclosed in the Roth patent to achieve an implantable device for drug delivery as claimed in the present application. The rejections set

forth in the Office Action appear to be improperly based on hindsight reconstruction in view of the present application or other recent/non-prior art publications.

9. I declare that all statements made herein of my own knowledge and belief are true and that all statements made on information and belief are believed to be true, and further that the statements are made with the knowledge that willful false statements are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

ROBERT S. LANGER

8/13/04
Date

ROBERT SAMUEL LANGER
Curriculum Vitae

DATE & PLACE OF BIRTH August 29, 1948, Albany, New York

EDUCATION

1974 Sc.D., Chemical Engineering, MIT
1970 B.S. (with distinction) Chemical Engineering, Cornell University

HONORS

2004 Charles F. Kettering Prize (GM Cancer Research Foundation)
2004 Pirkey Lectureship in Chemical Engineering (University of Texas, Austin)
2004 Evans Memorial Award Lectureship (Ohio State University)
2004 Nelson Taylor Lecturer and Awardee (Pennsylvania State University)
2004 Benjamin Zweifach Distinguished Lecturer (City College)
2004 Nelson Leonard Lecturer (University of Illinois)
2004 Donald Katz Lecturer (University of Michigan)
2003 Heinz Award for Technology, Economy and Employment
2003 Harvey Prize in Science and Technology and Human Health
2003 John Fritz Medal (American Association of Engineering Societies)
2003 Founders Lecturer (University of Wisconsin)
2003 Rohm and Hass Lecturer (Stanford University)
2003 Elected to the Academy of Achievement (Golden Plate Award)
2003 Tripathy Endowed Memorial Lecture (University of Massachusetts, Lowell)
2003 Skinner Memorial Lecture (Northwestern University)
2003 Honorary Doctorate (University of Liverpool, England)
2003 Maurice and Yetta Glicksman Lecturer (Brown University)
2003 FMC Lecturer (Princeton University)
2003 Seymour J. Kreshover Lecturer (National Institutes of Health)
2003 Whitaker Lecturer (American Society of Artificial Organs)
2002 Dickson Prize for Science (Carnegie Mellon University)
2002 Charles Stark Draper Award (National Academy of Engineering)
2002 Othmer Gold Medal (Chemical Heritage Foundation)
2002 Nagai Innovation Award (Controlled Release Society)
2002 Feigenbaum - Levine Lecturer (Beth Israel Hospital at Harvard Medical School)
2002 Honorary Doctorate (Hebrew University of Jerusalem)
2002 Herman Schwan Award (University of Pennsylvania)
2002 Distinguished Lecturer (University of Louisville)
2002 Institute Lecturer (American Institute of Chemical Engineers)
2001 Harrison Howe Award (American Chemical Society)
2001 Ullyot Lecturer (Chemical Heritage Foundation)
2001 Clapp Lecturer (Brown University)
2001 Julian Smith Lecturer (Cornell University)
2001 Mason Lecturer (Stanford University)
2001 Distinguished Lecturer (Carnegie Mellon)
2000 Herman Beerman Lecturer (Society for Investigative Dermatology)
2000 Millennial Lecturer (University of Liverpool)
2000 Bayer Lecture (University of Pittsburgh)
2000 Bayer Stein Honorary Lecture (University of Massachusetts at Amherst)
2000 Honorary Doctorate (The Catholic University of Louvain, Belgium)
2000 Glaxo Wellcome International Achievement Award (Royal Pharmaceutical Society of Great Britain)
2000 Millennial Pharmaceutical Scientist Award (Millennial World Congress of Pharmaceutical Sciences)
2000 William G. Lowrie Lectureship (The Ohio State University)
2000 Frank T. Gucker Lecturer (Indiana University)
2000 First Pierre Galletti Award (American Institute of Medicine & Biological Engineering)
2000 First Patten Distinguished Lectureship (University of Colorado at Boulder)

2000 Wallace Carothers Award (American Chemical Society, Delaware Section)
1999 American Chemical Society Award in Polymer Chemistry
1999 Esselen Award (American Chemical Society, Northeast Section)
1999 G.N. Lewis Medal and Lecturer (University of California at Berkeley)
1999 Beckman Lecturer (University of Illinois at Urbana)
1999 Reilly Lecturership (Notre Dame University)
1999 Ebert Prize (American Pharmaceutical Association)
1998 Outstanding Pharmaceutical Paper Award (Controlled Release Society)
1998 Lemelson-MIT Prize for Invention and Innovation
1998 The Nagai Foundation Tokyo International Prize
1998 Wagner Lectureship (University of Michigan)
1998 Ewing Halsell Foundation Lectureship (University of Texas Health Center, San Antonio)
1998 Robert R. Linton Distinguished Lecture; New England Society for Vascular Surgery
1998 Marcus Memorial Lecturer (Washington University, St. Louis)
1998 Joseph Stokes, Jr. Lecturnship (University of Pennsylvania)
1997 Killian Faculty Achievement Award (MIT)
1997 Wiley Medal (U.S. Food and Drug Administration)
1997 Honorary Doctorate (The Technion - Israel)
1997 William J. Rashkind Memorial Lecture (American Heart Association)
1997 Rohm and Haas Lecturer in Materials Chemistry (University of North Carolina)
1996 Gairdner Foundation International Award
1996 Honorary Doctorate (Eidgenossische Technische Hochschule-ETH, Switzerland)
1996 William Walker Award (American Institute of Chemical Engineers)
1996 Society of Plastics Engineers International Award
1996 Ebert Prize (American Pharmaceutical Association)
1996 Elected a Fellow of Biomaterials Science and Engineering
1996 The Berkeley Lecturer (University of California, Berkeley)
1996 Avis Distinguished Visiting Professor (University of Tennessee)
1995 International John W. Hyatt Service to Mankind Award (Society of Plastics Engineers)
1995 Ebert Prize (American Pharmaceutical Association)
1995 Distinguished Medical Scientist Lecturer (Ohio State University)
1995 Lacy Lecturer (California Institute of Technology
1995 Ralph Peck Memorial Lecturer (Illinois Institute of Technology)
1995 Elected a Fellow (American Association of Pharmaceutical Scientists)
1995 PEL Associates Award (PEL Associates, Groton, Connecticut)
1994 Whitaker Distinguished Lecturer (Biomedical Engineering Society)
1994 Elected to the American Academy of Arts and Sciences
1994 Elected a Fellow, Society of Biomaterials
1994 Miles Lecturer (Cornell University)
1994 Feigenbaum Memorial Lecturer (Beth Israel Hospital, Harvard Medical School)
1993 Distinguished Pharmac. Scientist Award (Highest Honor of the Amer. Assoc.of Pharm.Scient.)
1993 Kurt Wohl Memorial Lecturer (University of Delaware)
1993 Priestley Lecturer (Penn State University)
1992 Elected to the National Academy of Sciences
1992 Elected to the National Academy of Engineering
1992 American Chemical Society Award for Applied Polymer Science (Phillips Award)
1992 Perlman Memorial Award Lecturer (American Chemical Society, Biochemical Technology Division)
1992 Elected a Founding Fellow, American Institute of Medical and Biological Engineering
1992 Kelly Distinguished Lecturer (Purdue University)
1992 Miles Distinguished Lecturer (University of Pittsburgh)
1992 Outstanding Pharmaceutical Paper Award (Controlled Release Society)
1991 Organon Teknika Award (European Society for Artificial Organs)
1991 Charles M.A. Stine Award in Materials Science and Eng. (Am. Institute of Chem.Eng.)
1991 Louis W. Busse Lecturer (University of Wisconsin)

1991 Sidney Riegelman Lecturer (University of California, San Francisco)
1991 Ashton-Cary Lecturer (Georgia Institute of Technology)
1991 Sandoz-Dorsey Lecturer (Ohio State University)
1990 Professional Progress Award (American Institute of Chemical Engineers)
1990 Clemson Award for Basic Research (Society for Biomaterials)
1990 Outstanding Pharmaceutical Paper Award (Controlled Release Society)
1989 Elected to the Institute of Medicine of the National Academy of Sciences
1989 Creative Polymer Chemistry Award (American Chemical Society, Polymer Division)
1989 Outstanding patent in Massachusetts and one of the twenty outstanding patents in the U.S. (Intellectual Property Owners, Inc.)
1989 Founders Award for Outstanding Research (Controlled Release Society)
1989 Walter F. Enz Lecturer (University of Kansas)
1988 Elected to the Gordon Conference Research Council
1988 Elected Chairman, Gordon Conference on Drug Carriers in Biology and Medicine
1988 Robert Rushmer Lecturer (University of Washington, Seattle)
1988 1st Presidential Lecturer, Controlled Release Society (Basel, Switzerland)
1987 Biomedical Research Council Lecturer (University of Michigan)
1986 Food, Pharmaceutical and Bioengineering Award (American Institute of Chemical Engineers)
1986 Elmer L. Linseth Lecturer (Case Western Reserve University)
1983 Outstanding Paper, Institute of Electrical and Electronic Engineering
1983 Merck, Sharpe and Dohme Lecturer (University of Puerto Rico)
1982 Paper Listed as One of the Outstanding Papers of the Year, CHEMTECH
1982 Recipient of the first Dorothy W. Poitras Chair, MIT
1982 Outstanding Teacher Award, MIT Graduate Student Council

EMPLOYMENT

7/88-	Kenneth J. Germeshausen Professor of Chemical and Biomedical Engineering, MIT Department of Chemical Engineering; Whitaker College of Health Sciences, Technology, and Management; and the Harvard-MIT Division of Health Sciences and Technology
7/99-6/00	Senior Lecturer on Surgery, Harvard University, Harvard Medical School
7/85-6/88	Professor of Biochemical Engineering, MIT, Department of Applied Biological Sciences, Whitaker College of Health Sciences, Technology, and Management, and the Harvard-MIT Division of Health Sciences and Technology
7/81-6/85	Associate Professor of Biochemical Engineering, MIT, Department of Nutrition and Food Sciences and the Whitaker College of Health Sciences Technology, and Management, and the Harvard-MIT Division of Health Sciences and Technology
7/78-6/81	Assistant Professor of Nutritional Biochemistry, MIT, Deptartment of Nutrition and Food Sciences
7/77-6/78	Assistant Professor of Nutritional Biochemistry, MIT (Visiting), Department of Nutrition & Food Sciences
7/74-present	Research Associate, Children's Hospital Medical Center, Harvard Med. School, Boston, MA
9/72-6/74	Research Assistant, MIT
9/72-8/73	Chairman, Math and Science Departments, The Group School, Cambridge, MA

PROFESSIONAL AND ACADEMIC ORGANIZATIONS

Controlled Release Society (Elected President, 1991-1992) (Elected to Board of Governors, 1981-1985; Chairman, Regulatory Affairs Committee, 1985-1989).
Biomedical Engineering Society (Elected to the Board of Directors, 1991-1994)
American Institute of Chemical Engineers (Food, Pharmaceutical and Bioeng. Division)
American Chemical Society (Polymer Division)
American Society of Artificial Internal Organs (Program Committee 1984-1987; Membership Committee (1991-93)
International Society of Artificial Internal Organs
Scientific Advisory Board, Department of Chemical Engineering, Georgia Insititute of Technology (1992-2000)
Society for Biomaterials (Elected a Fellow, 1994)
American Association of Pharmaceutical Scientists (Elected a Fellow, 1995)

American Institute of Medical and Biological Engineers (Elected Founding Fellow, 1992; Elected Chair, College of Fellows, 1995)
The Science Board, the United States Food and Drug Administration (FDA) (highest Advisory Board of the FDA), 1995--2002 (Chair from 1999 -- 2002)
Scientific Advisory Board, Schepens Eye Institute, Harvard Medical School (1995-1998)
Board of Scientific Counselors, National Institutes of Health Center for Research Resources (1996-2001)
Scientific Advisory Board, Division of Chemistry and Chemical Engineering, California Institute of Technology (1999-)
Scientific Advisory Board, Department of Chemical Engineering, Princeton University (1999-)
Board of Overseers, Othmer Research Institute, Brooklyn Polytechnic Institute (2001-)
Board of Directors, McGovern Insitute, Massachusetts Institute of Technology (2001-)
Board of Directors, Whitehead Institute (2003)
Chair, Killian Award Committee (2004)

COURSES TAUGHT

20.002U	(1977 - 1988)	Laboratory in Applied Biology
20.S35	(1979 - 1988)	Pharmacological Engineering
20.11G	(1979 - 1988)	Analytical Practices in Biochemistry
HST 110	(1979 - 1981)	Renal Pathophysiology
20.113	(1987 - 1988)	Problems in Biotechnology
10.02J	(1989 -)	Biotechnology and Engineering
10.361	(1989 -)	Integrated Chemical Engineering
10.13	(1989 -1991)	Thermodynamics
10.984	(1990 -)	Biomedical Applications of Chemical Engineering
10.26	(1992 -)	Senior Chemical Engineering Project Laboratory

MIT ACTIVITIES

1972-73, 80-	Board of Trustees, MIT Community Service Fund
1972-74	Committee on Preprofessional Advising and Education, MIT
1972-74	Steering Committee, Urban Action, MIT
1977-85	Freshman Advisor
1978-	Undergraduate Advisor
1980-	Premedical Advisory Council, MIT
1977-80	Seminar Committee, Department of Applied Biological Sciences, MIT
1978-80	Asinari Committee, MIT
1979-88	Undergraduate Affairs Committee, Department of Applied Biological Sciences, MIT (Chairman, 1981-1985)
1980-84	MIT-Wellesley Upward Bound Joint Steering Committee
1981-82, 84-85	Financial Aid Committee, Department of Applied Biological Sciences, MIT
1981-86	Admissions Committee, Harvard-MIT Division of Health Sciences and Technology
1983-87	Curriculum Committee, Dept. of Applied Biological Sciences (Chairman, 1985-1987)
1983-87	Radiation Committee, MIT
1983-97	Sea Grant Committee, MIT (Chairman, 1993-1997)
1985-87	Admissions Committee, Harvard MD-POD Program
1986-92	Admissions Committee, MIT Medical Engineering-Medical Physics Program
1986-	Harvard-MIT Joint Committee on Health Sciences and Technology
1988	Search Committee for Department Head, Department of Chemical Engineering
1988-1992	Admissions Committee, Department of Chemical Engineering
1989-1991	Undergraduate Committee, Department of Chemical Engineering
1991-1993	Seminar Chairman, Department of Chemical Engineering
1993-	Board of Advisors, MIT Industrial Summer Session Program
1994-1995	Selection Committee for Co-Director of Harvard-MIT HST Program
2000-	Harvard-MIT Division of Health Sciences and Technology Advisory Council

EDITORIAL BOARDS

1983-2002	BIOMATERIALS- Editor
1987-	BIOMATERIALS, ARTIFICIAL CELLS, AND IMMOBILIZATION TECHNOLOGY (Associate Editor, 1991-)
1983-92	SELECTIVE CANCER THERAPEUTICS (CANCER DRUG DELIVERY)
1983	METHODS OF ENZYMOLOGY-DRUG DELIVERY SYSTEMS
1984-98	JOURNAL OF CONTROLLED RELEASE
1985-	BIOMEDICAL POLYMERS
1986-	ADVANCED DRUG DELIVERY SYSTEMS
1987-	DRUG DESIGN AND DELIVERY
1990-	MARINE BIOTECHNOLOGY
1991-94	CHEMISTRY OF MATERIALS
1991 -	CELL TRANSPLANTATION
1991 -	POLYMERS FOR ADVANCED TECHNOLOGIES
1991 -	DRUG TARGETING AND DELIVERY
1992-	INTERNATIONAL JOURNAL OF DRUG TARGETING
1992-	JOURNAL OF BIOACTIVE AND COMPATIBLE POLYMERS
1994-98	CANCER BIOTHERAPY AND RADIOPHARMACEUTICALS
1994-	JOURNAL OF PHARMACEUTICAL SCIENCE
1995-	TISSUE ENGINEERING
1995-	THE ENCYCLOPEDIA OF CONTROLLED DRUG DELIVERY
1996-	BIRKHAUSER: SYNTHETIC BIODEGRADABLE POLYMER SCAFFOLDS
1996-98	CHEMICAL AND ENGINEERING NEWS
1997-99	PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES
1997-	ANNUAL REVIEWS OF BIOMEDICAL ENGINEERING
1997-	BIOMEDICAL MICRODEVICES
1998-	DIABETES TECHNOLOGY & THERAPEUTICS
1999-	JOURNAL OF POLYMER SCIENCE, CHEMISTRY
1999-	PHARMACEUTICAL SCIENCE
1999-	REGENERATIVE MEDICINE
1999-	METHODS OF TISSUE ENGINEERING
1999-	ANGEWANDTE CHEMIE
2000-	EUROPEAN JOURNAL OF PHARMACEUTICAL SCIENCES
2002-	JOURNAL OF INVESTIGATIVE DERMATOLOGY-Associate Editor
2004-	MECHANICS AND CHEMISTRY OF BIOSYSTEMS

PUBLICATIONS

1. Gardner, C., Colton, C., Langer, R., Hamilton, B., Archer, M. and Whitesides, G., Enzymatic regeneration of ATP from AMP and ADP I. thermodynamics, kinetics, and process development, in Enzyme Engin., 1974, 2: 209-216, Pye, E. and Wingard, L. eds., Plenum Press, New York.
2. Gardner, C., Langer, R. and Colton, C., Dependence of pH of the hydroxylamine assay for acyl phosphates. Analy. Biochem., 76: 654-656, 1976.
3. Kessler, D., Langer, R., Pless, N. and Folkman, J., Mast cells and tumor angiogenesis. Int. J. Cancer, 18: 703-709, 1976.
4. Langer, R., Hamilton, B., Gardner, C. Archer, M.and Colton, C., Enzymatic regeneration of ATP I alternative routes. AIChE J., 22: 1079-1090, 1976.
5. Langer, R., Brem, H., Falterman, K., Klein, M. and Folkman, J., Isolation of a cartilage factor that inhibits tumor neovascularization. Science, 193: 70-72, 1976.
6. Langer, R. and Folkman, J., Polymers for the sustained release of proteins and other macromolecules. Nature, 263: 797-800, 1976.
7. Brem, S., Preis, I., Langer, R., Brem, H., Folkman, J. and Patz, A., Inhibition of neovascularization by an extract derived from vitreous. Am. J. Ophthal., 84: 323-328, 1977.
8. Klagsbrun, M., Langer, R., Levenson, R., Smith, S. and Lillehei, C., The stimulation of DNA synthesis and cell division in chondrocytes and 3T3 cells by a growth factor isolated from cartilage. Exp. Cell Res., 105: 99-108, 1977.
9. Langer, R., Gardner, C. and Colton, C., Enzymatic regeneration of ATP II: Equilibrium studies with acetate kinase and adenylate kinase. AIChE J., 23: 1-10, 1977.
10. Nemet, M., Solomon, B., Langer, R. and Colton, C., Enzymatic regeneration of ATP from AMP and ADP: III kinetic studies with the coupled enzyme system, in Enzyme Eng., 1977, 3: 85-91, E. Pye, ed., Plenum Press, New York.
11. Conn, H. and Langer, R., Continuous long-term intra-arterial infusion in the unrestrained rabbit. Lab. Anim. Sci., 28: 598-602, 1978.
12. Langer, R. and Folkman, J., Sustained release of macromolecules from polymers, in Poly. Del. Systems, Midland Macro. Monograph, 1978, 5: 175-196, R. Kostelnik, ed., Gordon and Breach, New York.
13. Augustin, A. and Langer, R., Inhibitors to tumor vascularization and their delivery systems: possible extension to diabetes research, in Ocular and Systemic Disorders, 1979, 33-36, R. Fair, ed., American Optometric Association, St. Louis.
14. Tapper, D., Langer, R., Conn, H. and Folkman, J., Oxygen content determined by acrylamide polymerization: screening of anticancer agents, generation of oxyhemoglobin dissociation curves and potential applications. Ann. Surg., 189: 275-283, 1979.
15. Preis, I. and Langer, R., A single-step immunization by sustained antigen release. J. of Immuno. Meth., 28: 193-197, 1979.
16. Tapper, D., Langer, R., Bellows, A.and Folkman, J., Angiogenesis capacity as a diagnostic marker for human eye tumors. Surgery, 86: 36-40, 1979.
17. Rhine, W., Hsieh, D. and Langer, R., Polymers for sustained macromolecule release: Procedures to fabricate reproducible delivery systems and control release kinetics. J. Pharma. Sci., 69: 265-270, 1980.
18. Conn, H., Berman, M., Kenyon, K., Langer, R. and Gage, J., Stromal vascularization prevents corneal ulceration. Invest. Ophthal., 19: 362-370, 1980.
19. Creque, H., Langer, R. and Folkman, J., One month sustained release of insulin from a polymer implant. Diabetes 29: 37-41, 1980.
20. Augustin, A. and Langer, R., Studies of inhibitors to tumor neovascularization and their delivery systems, Diabetes, 29: 33-35, 1980.
21. Langer, R., Fefferman, M., Gryska, P. and Berman, K., A simple method for studying chemotaxis using sustained release of attractants from inert polymers. Can. J. Microbiol., 26: 274-278, 1980.
22. Langer, R., Conn, H., Vacanti, J., Haudenschild, C. and Folkman, J., Control of tumor growth in animals by infusion of an angiogenesis inhibitor. Proc. of the Nat. Acad.of Sci., 77: 4331-4335, 1980.
23. Langer, R., Polymeric delivery systems for controlled drug release. Chem. Eng. Commun., 6: 1-48, 1980.

24. Langer, R. and Folkman, J., Controlled release of macromolecules from polymers, in Biomedical Poly., 1980, 113-139, E. Goldberg, A. Nakajima eds., Academic Press, New York.
25. Langer, R., Rhine, W., Hsieh, D. and Bawa, R., Polymers for the sustained release of macromolecules: Applications and control of release kinetics, in Contr. Rel. of Bioactive Mat., 1980, 83-98, R. Baker, ed., Academic Press, New York.
26. Langer, R., Rhine, W., Hsich, D. and Folkman, J., Control of release kinetics of macromolecules from polymers., J. Memb. Sci., 7: 333-350, 1980.
27. Rhine, W. Sukhatme, V., Hsieh, D. and, Langer, R., A new approach to achieve zero-order release kinetics from diffusion-controlled polymer matrix systems, in Cont. Rel. of Bioactive Mat., 1980, 177-188 R. Baker, ed., Academic Press. New York.
28. Folkman, J., Ausprunk, D. and Langer, R., Connective tissue: Small blood vessels and capillaries, in Textbook of Rheumatology, 1981, 210-220, W. Kelly, E. Harris, S. Ruddy, C. Sledge, eds., W.B. Saunders Co.
29. Conn, H., Langer, R., Iodine disinfection of hydrophilic contact lenses, Ann. Ophthal., 13: 361-364, 1981.
30. Langer, R. Polymers for sustained release of macromolecules: their use in a single-step method of immunization, in Immunological Techniques, Methods in Enz., 1981, 73: 57-75 H. Vunakis, J. Langone, eds., Academic Press, N.Y.
31. Hsieh, D., Langer, R., Folkman, J., Magnetic modulation of release of macromolecules from Polymers. PNAS 78: 1863-1867, 1981.
32. Galliher, P., Cooney, C., Langer, R., Linhardt, R., Heparinase production by flavobacteria, Appl. Env. Microbiology, 41: 360-365, 1981.
33. Langer, R., Brem, H., Tapper, D., Biocompatibility of polymeric delivery systems for macromolecules, J. Biomed. Mat. Res., 15: 267-277, 1981.
34. Langer, R., Controlled Release: A new approach to drug delivery, Tech. Rev., 83: 26-34, 1981.
35. Langer, R., Karel, M. Controlled release technology: Polymers in medicine, food and agriculture. Poly. News, 7: 250-258, 1981.
36. Langer, R., Hsieh, D., Brown, L., Rhine, W., Polymers for the sustained release of macromolecules: Controlled and magnetically modulated systems, in Better Therapy With Existing Drugs: New Uses and Del. Sys., 1981, 179-216, A. Bearn ed., Merck & Co., Biomedical Information Corporation, New York.
37. Hsieh, D., Langer, R., Experimental approaches for achieving both zero-order and modulated controlled release from polymer matrix systems, in Cont. Rel. of Pesticides and Pharm., 1981, 5-16, D. Lewis ed., Plenum Press, NY.
38. Langer, R., Folkman, J., Angiogenesis Inhibitors in molecular actions and targets for cancer chemotherapeutic agents, 1981, 511-525, A. Sartorelli, J. Lazo, J. Bertino, eds., Academic Press, New York.
39. Langer, R., Hsieh, D., Peil, A., Bawa, R., Rhine, W., Polymers for controlled release of macromolecules: Kinetics, applications, external control, in Cont. and Topical Rel. of Drugs to the Body, 1981, 206: 10-20, S. Chandresekaran, J. Eckenhoff, eds., AIChE Symposium Series.
40. Mayberg, M., Langer, R., Zervas, N., Moskowitz, M., Perivascular meningeal projections from at trigeminal ganglia: possible pathway for vascular headaches in man. Science, 213: 228-230, 1981.
41. Moskowitz, M., Mayberg, M., Langer, R., Controlled release of horseradish peroxidase from polymers: A method to improve histochemical localization and sensitivity, Brain Res., 212: 460-465, 1981.
42. Langer, R., Peppas, N., Present and future applications of biomaterials in controlled drug delivery systems, Biomaterials, 2: 195-210, 1981.
43. Langer, R., Urquhart, J. Blackshear, P., Implantable drug delivery systems, Trans. Am. Soc. Art. Int. Organs, 27: 648-654, 1981.
44. Peil, A., Barrett. F., Rha, C., Langer, R,. Retention of micro-nutrients by polymer coatings used to fortify rice, J. Food Science, 47: 260-262, 1981.
45. Langer, R., Linhardt, R., Klein, M., Flanagan, M., Galliher, P., Cooney, C., A system for heparin removal, in Biomaterials: Interfacial Phenomena and Applications, 1982, 493-509, S. Cooper, A. Hoffman, N. Peppas, B. Rattner, eds., Advances in Chemistry Series, Washington, DC.
46. Berman, M., Winthrop, S., Ausprunk, D., Rose, J., Langer, R., Gage, J., Plasminogen activator (urokinase) causes vascularization of the cornea. Invest. Ophthal., 22: 191-199, 1982.
47. Langer, R., Hsich, D., Brown, L., Polymeric delivery systems for macromolecules: Approaches for studying in vivo release kinetics and designing constant rate dsystems, in Biol. Activities of Polymers, 1982, 186: 95-197. C. Carraher, Gebelein, C. eds., American Chemical Society Symposium Series.

48. Linhardt, R., Fitzgerald, G., Cooney, C., Langer, R., Mode of action of heparin lyase E.C. 4227 on heparin, Biochem. Biophys. Acta., 702: 197-203, 1982.
49. Langer, R. Controlled release of macromolecules, Chemtech, 12: 98-105, 1982.
50. Langer, R., Linhardt, R., Cooney, C., Tapper, D., Klein, M., Immobilized heparinase: Production, purification and application in extracorporeal therapy, in Enzyme Eng. 1982, 6: 433-441 I. Chibata, S. Fukui, L. Wingard, B., eds., Plenum Press, NY.
51. Klein, M., Drongowski, R., Linhardt, R., Langer, R., A colorimetric assay for chemical heparin in plasma. Analy. Biochem. 124: 59-64, 1982.
52. Linhardt, R., Grant, A., Cooney, C., Langer, R., Differential anticoagulation activity of heparin fragments prepared using microbial heparinase, J. Biol. Chem., 257: 7310-7313, 1982.
53. Langer, R., Linhardt, R., Hoffberg, S., Larsen, A., Cooney, C., Tapper, D., Klein, M., An enzymatic system for removing heparin in extracorporeal therapy. Science, 217: 261-263, 1982.
54. Cooney, C. Galliher, P., Langer, R., Linhardt, R., Conway, L., Regulation of heparinase synthesis in flavobacteria heparinum, Europ. J. Appl. Microbiol. 15: 252-257, 1982.
55. Langer, R., Linhardt, R., Larsen, A., Cooney, C., Tapper, D., Klein, M., *In vivo* activity of microbial heparinase, Trans. Am. Soc. Art. Int. Organs, 28: 387-390, 1982.
56. Langer, R., Murray, J. Angiogenesis inhibitors and their delivery systems, Appl. Biochem. and Biotech., 8: 9-24, 1983.
57. Hsich, D., Rhine, W., Langer, R., Zero-order controlled release polymer matrices for micromolecules and macromolecules, J. Pharm. Sci. 72: 17-22, 1983.
58. Rosen, H., Chang, J., Wnek, G., Linhardt. R., Langer, R., Bioerodible polyanhydrides for controlled drug delivery. Biomaterials 4: 131-133, 1983.
59. Langer, R. Edelman, E., Hsieh, D. Magnetically controlled polymeric delivery systems, in Biocompatible Poly., Sci. and Tech., 585-596, 1983.
60. Langer, R., New drug delivery systems. Drug Therapy, 13: 217-231, 1983.
61. Hsieh, D., Langer, R., Zero-order drug delivery systems with magnetic control, in Cont. Rel. of Bioactive Mat., 1983,121-131, Z. Mansdorff and T.J. Roseman, eds., Marcel Dekker, NY.
62. Langer, R., Implantable controlled release systems, Pharm. and Therapeutics, 21: 35-51, 1983.
63. Langer, R., Peppas, N., Chemical and physical structure of polymers as carriers for controlled release of bioactive agents: A review, J. Macromol. Sci., 23: 61-126, 1983.
64. Brown, L., Wei, C., Langer, R., *In vitro* and *in vivo* release of macromolecules from polymeric drug delivery systems, J. Pharm. Sci., 72: 1181-1185, 1983.
65. Lee, A., Langer, R., Shark cartilage contains inhibitors of tumor angiogenesis, Science, 221: 1185-1187, 1983.
66. Kupchik, H., Langer, R., Haberern, C., El Deriny, S., O'Brien, M., A new method for the three dimensional *in vitro* growth of human cancer cells, Exper. Cell. Res., 147: 454-459, 1983.
67. Folkman, J., Langer, R., Linhardt, R., Haudenschild, C., Taylor, S., Angiogenesis inhibition and regression of large tumor masses caused by heparin or a heparin fragment in the presence of cortisone, Science, 221: 719-725, 1983.
68. Murray, J., Brown, L., Klagsbrun, M., Langer, R., A micro sustained release system for epidermal growth factor, In Vitro, 19: 743-748, 1983.
69. Klein, M., Drongowski, R., Linhardt, R., Cooney, C., Langer, R., Heparinase: *In vivo* activity and immunogenicity in rabbits, J. Lab. and Clin. Med., 102: 828-837, 1983.
70. Siegel, R. Langer, R., Controlled release of polypeptides and other macromolecules, Pharm. Research, 1: 2-10, 1984.
71. Grant, A., Linhardt, R., Fitzgerald, G., Park J., Langer, R., Metachromatic activity of heparin and heparin fragments, Analy Biochem., 137: 25-28, 1984.
72. Lee, A., Langer, R., Shark cartilage contains an inhibitor of tumor neovascularization, in Biotech. and Genetic Engin. in the Marine Sci., 1984, 215-220, A. Sinskey, E. Pariser, R. Colwell, eds., John Wiley and Sons, Inc., NY.
73. Larsen, A., Linhardt, R., Klein, M., Tapper, D., Langer, R., Effect of extracorporeal enzymatic deheparinization and its effect on formed blood components, Art. Organs, 8: 198-203, 1984.
74. Langer, R., Polymers and drug delivery systems, in Long-Acting Contraceptive Del. Sys., 1984, 23-32, G. Zatuchni, J. Goldsmith, J. Shelton, eds. Harper and Row, Philadelphia.
75. Murray, J., Brown, L., Langer, R,. Controlled release of or microquantities of macromolecules, Cancer Drug Del., 1: 119-123, 1984.

76. Lee, A., Von Beuzekom, M., Glowacki, J., Langer, R., Inhibitors enzymes and growth factors from shark cartilage, Comp. Physiol & Biochem., 78B: 609-616, 1984.
77. Linhardt, R., Cooney, C., Zannetos, C., Larsen, A., Tapper, D., Langer, R., An immobilized microbial heparinase for blood deheparinization, Appl. Biochem. and Biotech., 9: 41-55, 1984.
78. Kost, J., Langer, R., Controlled release of bioactive agents, Trends in Biotech., 2: 47-51, 1984.
79. Siegel, R., Cohen, J., Brown, L., Langer, R., Sintered polymers for sustained macromolecular drug release, in Recent Adv. in Drug Del. Sys., 1984, 315-320, J. Anderson, S. Kim, eds. Plenum Press, NY.
80. Langer, R., Brown, L., Edelman, E., Controlled release and magnetically modulated systems for macromolecules: Recent advances, in Rec. Adv. in Drug Del. Sys., 1984, 249-258, J. Anderson, S. Kim, eds. Plenum Press, NY.
81. Cohen, J., Siegel, R., Langer, R., Sintering technique for preparation of polymer matrices for the sustained release of macromolecules, J. Pharm. Sci., 73: 1034-1037, 1984.
82. Langer, R., Macromolecular delivery systems for therapeutic applications of controlled drug release, in Contemp. Biomat., 1984, 560-572, J. Boretos, M. Eden, eds., Noyes Publications.
83. Larsen, A., Hetelekidis, S., Langer, R., Disposition and anticoagulant activity of biologically active heparin fragments in the rat. J. Pharm. & Exper. Ther., 231: 373-378, 1984.
84. Edelman, E., Brown, L., Kost, J., Taylor, J., Langer, R., Modulated release from polymeric drug delivery systems using oscillating magnetic fields: in vitro and in vivo characteristics. Trans. Amer. Soc. Art. Int. Organs 30: 445-447, 1984.
85. Larsen, A., Hetelekidis, S., Langer, R., Enzymatic extracorporeal deheparinization: Effects of subchronic exposure to heparin fragments, Trans. Amer. Soc. Art. Int. Organs, 30: 298-302, 1984.
86. Wheatley, M., Langer, R. Polymeric microsphere for controlled drug delivery, in Microspheres and drug therapy, 1984, 341-345, S. Davis, L. Illum, J. McVie, E. Tomlinson, eds. Elsevier Press.
87. Sefton, M., Brown, L., Langer, R. Ethylene-vinyl acetate microspheres for controlled release of macromolecules, J. Pharm. Sci., 73: 1859-1861, 1984.
88. Kohn, J., Langer, R., A new approach to the development of bioerodible polymers for controlled release applications employing naturally occurring amino acids, in Proc. ACS Div. Poly. Mat.: Sci. Eng. American Chemical Society, 51: 119-121, 1984.
89. Balazs, A., Calef, D., Deutch, J., Siegel, R., Langer, R., The role of polymer matrix structure & interparticle interactions in diffusion limited drug release, Biophys. J., 47: 97-104, 1985.
90. Folkman, J., Ausprunk, D., Langer, R., Connective tissue: Small blood vessels and capillaries, in Textbook of Rheumatology, 1985, 197-210, W. Kelley, E. Harris, S. Ruddy, C. Sledge, eds., W.B. Saunders Co., Philadelphia.
91. Yang, V., Linhardt, R., Bernstein, H., Cooney, C., Langer, R., Purification and characterization of heparinase from flavobacterium heparinum, J. Biol. Chem., 260: 1849-1857, 1985.
92. Edelman, E., Kost, J., Bobeck, H., Langer, R., Regulation of drug release from porous polymer matrices by oscillating magnetic fields, J. Biomed. Mat. Res., 19: 67-83, 1985.
93. Hsu, T., Langer, R., Polymers for the controlled release of macromolecules: Effect of molecular weight of ethylene-vinyl acetate copolymer, J. Biomed. Mat. Res., 19: 445-460, 1985.
94. Levy, R., Wolfrum, J., Schoen, F., Hawley, M., Lund, S., Langer, R., Inhibition of calcification of bioprosthetic heart valves by local controlled release diphosphonate, Science, 228: 190-192, 1985.
95. Yang, V., Langer, R. A rapid method for isoelectric point estimation,. Anal. Bio. Chem., 147: 148-155, 1985.
96. Langer, R., Brown, L., Edelman, E. Controlled release and magnetically modulated release systems for macromolecules, in Drug and Enz. Targeting. Meth. in Enzym., 112: 399-423, 1985.
97. Langer, R., Siegel, R., Brown, L., Leong, K., Kost, J., Edelman, E. Controlled release and magnetically modulated systems for macromolecular drug. Ann. of the New York Acad. of Sci., 446: 1-13,1985.
98. Bawa, R., Siegel, R., Marasca, B., Karel, M., Langer, R. An explanation for the sustained release of macromolecules from polymers. J. Cont. Rel., l: 259-267, 1985.
99. Langer, R., Biomaterials: new perspectives on their use in the controlled delivery of polypeptides. Pharm. Techn., 9: 37-39, 1985.
100. Lavin, A., Sung, C., Klibanov, A., Langer, R. Enzymatic removal of bilirubin from blood: a potential treatment for neonatal jaundice. Science, 230: 543-546, 1985.
101. Kost, J., Noekker, R., Kunica, E., Langer, R. Magnetically controlled release systems: Effect of polymer composition. J. Biomed. Mat. Res., l9: 935-940, 1985.

102. Leong, K., Brott, B., Langer, R. Bioerodible polyanhydrides as drug-carrier matrices: I. characterization, degradation and release characteristics. J. Biomed. Mat. Res., 19: 941-955, 1985.
103. Yang, V., Morgan, L., McCarthy, M., Langer, R. Isoelectric points of the polysaccharide degrading enzymes in flavobacterium heparinum. Carbo. Res., 143: 1-6, 1985.
104. Langer, R., Larsen, A., Bernstein, H., Yang, V., Lund, D., Tapper, D. Enzymatic control of anticoagulation. ASAIO J., 8: 213-214, 1985.
105. Linhardt, R., Merchant, Z., Rice, K.G., Kam, Y., Fitzgerald, G., Grant, A., Langer, R. Evidence of random structural features of the heparin polymer. Biochemistry, 24: 7805-7810, 1985.
106. Levy, R., Golomb, G., Wolfrum, J., Lund, S.A., Schoen, F., Langer, R. Local controlled release of diphosphonates from ethylenevinyl acetate matrices prevents bio-prosthetic heart valve calcification. Am. Soc. Artif. Intern. Organs, 31: 459-463, 1985.
107. Sung, C., Lavin, A., Klibanov, A., Langer, R. An immobilized enzyme reactor for treatment of severe neonatal jaundice. ASAIO J. 31: 264-268, 1985.
108. Langer, R., Lund, D., Leong, K., Folkman, J. Controlled release of macromolecules: Biological studies. J. Cont. Rel., 2: 331-341, 1985.
109. Niemi, S., Fox, J., Brown, L., Langer, R. Evaluation of ethylene-vinyl acetate copolymer as a noninflammatory alternative to Freund's complete adjuvant in rabbits. Lab. Animal Sci., 35: 609-612, 1985.
110. Langer, R. Bioavailability of macromolecular drugs and its control in controlled drug bioavailability. Bioavailability Cont. by Drug Del. Sys. Design, 1985, 3: 307-364, V. Smolen, ed., J. Wiley and Sons, NY.
111. Leong, K., D'Amore, P., Marletta, M., Langer, R. Bioerodible polyanhydrides as drug-carrier matrices: II: biocompatibility and chemical reactivity. J. Biomed. Mat. Res., 20: 51-64, 1986.
112. Brown, L., Edelman, E., Siemer, L., Langer, R. Controlled-release systems for macromolecules: methods and applications, in Adv. in Carriers and Adjuvants for Veterinary Biologics, 1986, 133-141. Nervig, ed., The Iowa State University Press.
113. Siegel, R., Langer, R. A new monte carlo approach to diffusion in constricted porous geometrics. J. Colloid Interfacial Sci., 109: 426-440, 1986.
114. Murray, J., Allison, K., Sudhalter, J., Langer, R. Purification and partial amino acid sequence of a collagenase Inhibitor from Bovine Cartilage. J. Biol. Chem., 261: 4154-4159, 1986.
115. Kost, J., Langer, R. Magnetically modulated delivery systems. Pharm. International, 7: 60-63, 1986.
116. Cerbelaud, E., Conway, L., Galliher, P., Langer, R., Cooney, C. Sulfur regulation of heparinase and sulfatases in Flavo-bacterium heparinum. Appl. and Envir. Microbiol., 51: 640-646, 1986.
117. Kohn, J., Langer, R. Poly(Iminocarbonates) as Potential New Biomaterials. Biomaterials, 7: 176-182, 1986.
118. Larsen, A., Lund, D., Langer, R., Folkman, J. Oral heparin results in the appearance of heparin fragments in the Plasma of Rats. PNAS 83: 1-5, 1986.
119. Brown, L., Siemer. L., Langer, R. Controlled release of insulin from polymer matrices: *in vitro* kinetics. Diabetes, 35: 684-691, 1986.
120. Brown, L., Siemer, L, Munoz, C., Edelman, E., Langer, R. Controlled release of insulin from polymer matrices: control of diabetes in rats. Diabetes, 35: 692-697, 1986.
121. Edelman, E., Linhardt, R., Bobeck, H., Kost, J., Rosen, H., Langer, R. Polymer based drug delivery: magnetically nodulated and bioerodible systems, in Poly. as Biomat., S. Shalaby, A. Hoffman, T. Horbett, B. Ratner, eds., Plenum Press, N.Y., p. 279-292, 1986.
122. Langer, R. Biopolymers in controlled release systems, in Polymeric Biomat., E. Pishkin, A. Hoffman, eds., Martinus Nijhoft Publishers, Dordrecht, pp. 161-169, 1986.
123. Klein, M., Langer, R. Immobilized enzymes in clinical medicine: a new approach to the treatment of disease. Trends in Biotech., 4: 179-186, 1986.
124. Sung, S., Lavin, A., Klibanov, A., Langer, R. An immobilized enzyme reactor for the detoxification of bilirubin. Biotech. Bioeng. 28: 1531-1539, 1986.
125. Leong, K., Kost, J., Mathiowitz, E., Langer, R. Polyanhydrides for the controlled release of bioactive agents. Biomaterials, 7: 364-371, 1986.
126. Kohn, J., Albert, E., Wilchek, M., Langer, R. Identification and colorimetric determination of organic cyanates (R-O-C=N) in nanomolar quantities. Anal. Chem., 58: 3184-3188, 1986.
127. Kohn, J., Niemi, S., Albert, E., Murphy, J., Langer, R., Fox, J. Single-step immunization using a controlled release, biodegradable polymer with sustained adjuvant activity. J. Immuno. Methods, 95: 31-38, 1986.

128. Langer, R., Blackshear, P., Chang, T., Klein, M., Schultz, J. Enzyme and drug delivery systems. ASAIO Trans., 9: 639-645, 1986.
129. Blackshear, P., Robbins, D., Rohde, T., Langer, R., Moses, A., Massey, E. Insulin replacement: current concepts. ASAIO Trans., 9: 646-655, 1986.
130. Yang, V., Bernstein, H. Kadam, J., Cooney, C., Langer, R. Removal of the anticoagulant activities of the low molecular weight heparin fractions and fragments with flavobacterial heparinase. Thrombosis Res., 44: 599-610, 1986.
131. Golomb, G., Langer, R., Schoen, F., Smith, M., Choi, Y., Levy, R. Controlled release of diphosphonate to inhibit bioprosthetic heart valve calcification: dose-response and mechanistic studies. J. Cont. Rel., 4: 181 - 194, 1986.
132. Kost, J., Leong, K., Langer, R. Ultrasonic modulated drug delivery systems in polymers, in Med., Biom. and Pharm. Appl. II, E. Chiellini, ed., Plenum Press, 387-396, 1986.
133. Langer, R., Siegel, R., Brown, L., Leong, K., Kost J., Edelman, E. Controlled release systems: Three mechanisms. Chemtech, 16: 108-110, 1986.
134. Yang, V., Bernstein, H., Langer, R. Heparinase immobilization: characterization and optimization, in Methods in Enzymology, 515-520, 1987.
135. Kohn, J., Langer, R. Polymerization reactions involving the side chains of a-L-amino acids. J. Am. Chem. Soc., 109: 817-820, 1987.
136. Edelman, E., Brown, L., Langer, R. In vitro and in vivo kinetics of regulated drug release from polymer matrices by oscillating magnetic fields. J. Biomed. Mat. Sci., 21: 339-353, 1987.
137. Yang, V., Bernstein, H., Langer, R. Large scale purification of catalytically pure heparinase. Biotech. Progress, 3:1 27-30, 1987.
138. Yang, V., Langer, R. A simple and economic technique for pI measurements. Biotechniques, 5: 138-144, 1987.
139. Leong, K., Simonte, V., Langer, R. Synthesis of polyanhydrides: melt-polycondensation, dehydrochlorination, and dehydrative coupling. Macromolecules, 20: 705-712, 1987.
140. Linhardt, R., Langer, R. New approaches for anticoagulation in extracorporeal therapy. Biomat. Art . Cells, Art. Org., 15: 91-100, 1987
141. Langer, R., Bioengineering: its role in the changing face of chemical engineering. Biotech. Progress, 3: 2, 1987
142. Laurencin, C., Langer, R. Drug delivery systems. Clinics in Lab. Med., 7: 301-323, 1987.
143. Kost, J. Langer, R. Equilibrium swollen hydrogels in controlled release applications, in Hydrogels in Med. Pharm., N. Peppas, ed., Vol. II, CRC Press, Boca Raton, FL, pp. 95-108 1987.
144. Bernstein, H., Yang, V., Langer, R., The distribution of heparinase covalently immobilized to agarose: experimental and theoretical studies. Biotech. Bioeng., 30; 196-207, 1987.
145. Bernstein, H., Yang, V., Langer, R. Immobilized heparinase in vitro reactor model. Biotech. Bioeng., 30: 239-250, 1987.
146. Mathiowitz, E., Langer, R. Polyanhydride microspheres as drug carriers. J. Cont. Rel., 5: 1322, 1987.
147. Saltzman, W., Pasternack, S., and Langer, R. Microstructural models for diffusive transport in porous polymers, in Recent Adv. in Cont. Rel. Tech., ACS Symposium Series, P. Lee, W. Good, eds. 348: 16-33, 1987.
148. Saltzman, W., Pasternak, S., Langer, R. Quantitative image analysis for developing microstructural descriptions of heterogeneous materials. Chem. Eng. Sci., 42: 1989-2004, 1987
149. Bernstein, H., Yang, V., Randawa, M., Lund, D., Harmon, W., Langer, R. Extracorporeal enzymatic heparin removal: use in a sheep dialysis model. Kidney Int., 32: 452-463, 1987
150. Mathiowitz, E., Cohen, M., Langer, R. Novel microcapsules for delivery systems. Reactive Poly. Ion Exchange Sorbents, 6: 275-283, 1987.
151. Mullon, C., Langer, R. A new method for measuring conjugated and total bilirubin in neonate plasma using bilirubin oxidase. Clin Chem. 33: 1822-1825, 1987.
152. Domb, A., Langer, R. Polyanhydrides: I. preparation of high molecular weight polyanhydrides. J. Poly. Sci., 25: 3373-3386, 1987.
153. Kost, J., Wolfrum, J., Langer, R. Magnetically controlled insulin release in diabetic rats. J. Biomed. Mat. Res., 21: 1367-1373, 1987.
154. Levy, R., Golomb, G., Langer, R. Prevention of Cardiovascular calcification with controlled release diphosphate, in Artificial Organs: The W.F. Kolff Festschrift, J. Andrade, ed., VCH Publishers, Inc., pp. 657- 670, 1987.
155. Bernstein H., Langer, R. An immobilized enzyme system for heparin removal, in Art. Organs: The W.F. Kolff Festschrift, J. Andrade ed., VCH Publishers, pp. 333-342, 1987.

156. Cuenoud, H., Joris, I., Langer, R., Majno, G. Focal arteriolar insudation: A response of arterioles to Chronic Non-Specific Irritation. Amer. J. Path., 127: 592-604, 1987.
157. Laurencin, C., Koh, H., Neenan, T., Alcock, H., Langer, R. Controlled release using a new bioerodible polyphosphazene matrix system. J. Biomed. Mater. Res., 21: 1231-1246, 1987.
158. Yang, V., H. Bernstein, C. Cooney, Langer, R. Large scale preparation and characterization of mucopolysaccharase contamination free heparinase. Appl. Biochem. Biotech., 16: 35-50, 1987.
159. Wheatley, M., Langer, R. Particles as drug delivery systems. Particulate Sci. and Tech., 5: 53-65, 1987.
160. Langer, R., Leong, K., Edelman, E., Siegel, R., Bawa, R. Zero order release, magnetic control, and polypeptide release, in Cont. Drug Del. Sys., P. Reisen, ed., International Association for Pharm. Technology, Frankfurt, 146-160, 1987.
161. Thompson, R.W., Folkman, J., Langer, R., Ingber, D. Sudhalter, J. D'Amore, P. Angiogenic vascular grafts, in Endothelizilization of Vascular Grafts, Zilla, Fasol, Deutsch, eds. Karger, Basel, 167-176, 1987.
162. Bernstein, H., Yang, V., Langer, R. An investigation of heparinase immobilization. Applied Biochem. and Biotech., 129-143, 1987.
163. Kohn, J., Langer, R. Backbone modifications of synthetic poly-alpha amino acids, in Peptides, Chem. and Biology, G. Marshall, ed., Escom Publishing, Leiden, The Netherlands, pp. 658-661, 1988.
164. Brown, L., Langer, R. Transdermal drug delivery systems. Ann. Rev. of Med., 39: 221-229, 1988.
165. Mullon, C., Klibanov, A., Langer, R. Kinetics of bilirubin oxidase and modeling of an immobilized bilirubin oxidase reactor for bilirubin detoxification. Biotech. Bioeng., 31: 536-546, 1988.
166. Domb, A., Ron, E., Langer, R. Polyanhydrides II. One step polymerization using phosgene or diphosgene as coupling agents. Macromolecules, 21: 1925-1929, 1988.
167. Fischel-Ghodsian, F., Brown, L., Mathiowitz, E., Brandenburg, D., Langer, R. Enzymatically controlled drug delivery. Proc. Nat. Acad.Sci., 85: 2403-2406, 1988.
168. Bernstein, H., Yang, V., Cooney, C., Langer, R. An immobilized heparinase system for blood deheparinization, Meth. Enz., K. Mosbach, ed., Academic Press, 137: 515-529, 1988.
169. Domb, A., Langer, R. Polyanhydrides: stability and novel composition. Makromol. Chem. Macromol. Symp. 19: 189-200, 1988.
170. Comfort, A., Mullon, C., Langer, R. The influence of bond chemistry on immobilized enzyme systems for ex vivo use. Biotech. and Bioeng., 32: 554-563, 1988.
171. Bindschacdler, C., Leong, K., Mathiowitz, E. Langer, R., Polyanydride microsphere formulation by solvent extraction. J. Pharm. Sci., 77: 696-698, 1988.
172. Domb, A., Cravalho, E.G., Langer, R. The synthesis of poly(hydroxamic) from poly(Acrylamide). J. Poly. Sci., 26: 2623-2630, 1988.
173. Kost, J., Leong, K., Langer, R. Ultrasonically controlled colymeric drug delivery. Makromol. Chem. Macromol. Symp. 19: 275-285, 1988.
174. Comfort, A., Mullon, C., Koh, J., Albert, E., Tosone, C., Hall, P., Langer, R. Stability and immunologic activity of immobilized heparinase and bilrubin oxidase. ASAIO Transactions, 34: 538-2542, 1988
175. Freed, L., Vunjak, G., Drinker, P., Langer, R. A novel bioreactor based on suspended particles of agarose-immobilized species. ASAIO Transactions, 34: 732-738, 1988
176. Mullon, C., Saltzman, W., Langer, R. Computer based visualization for quantitative and analysis of the distribution of matrix-bound proteins. Bio/Technology, 6: 927-929, 1988.
177. Rosen, H., Kohn, J., Leong, K., Langer, R. Bioerodible polymers for controlled release systems, in Cont. Rel. Sys.: Fab. Tech., D. Hsieh, ed., CRC Press, Boca Raton, FL, Vol. II, Chap. 5, 84-110, 1988.
178. Yang, V., Bernstein, H., Cooney, C., Langer, R. The development of an immobilized heparinase reactor in bioreactors, immobilized enzymes and cells, and fundamentals in the applications, M. Moo-Young, ed., Elsevier Applied Science, NY, 83-94, 1988.
179. Bernstein, H., Langer, R. Ex vivo model of an immobilized enzyme reactor. PNAS 85: 8751-8755, 1988.
180. Klein, M., Arensman, R., Weber, T., Mottaghy, K., Langer, R., Nolte, S.H. Pediatric ECMO: directions for new developments. Trans. Am. Soc. Artif. Intern. Organs., 34: 978-985, 1988.
181. Karel, M., Langer, R. Controlled release of food additives, in Flavor Encapsulation, ACS Symp. Ser. 370. S. Risch G.Reineccius, eds), 177-191, 1988.
182. Langer, R. Controlled release systems, in Chem. Eng. Ed. in a Changing Environment, S. Sandler, B. Finlayson eds., 115-124, 1988.

183. Leong, K. Langer, R. Polymeric controlled drug delivery. Adv. Drug Del. Rev., I, 199- 233, 1988.
184. Langer, R. Biodegradable polymers for drug delivery to the brain. ASAIO Transactions, 34: 945-946, 1988.
185. Larsen, A., Rice, K., Linhardt, R., Wogan, G., Langer, R. Resistance of heparinase-derived heparin fragments to biotransformation. J. Biol. Chem., 264: 1570-1577, 1988.
186. Vacanti, J., Morse, M., Saltzman, M., Domb, A., Perez-Atayde, A., Langer, R., Selective cell transplantation using bioabsorbable artificial polymers as matrices,. J. Ped. Surg., 23: 3-9, 1988.
187. Mathiowitz, E., Saltzman, M., Domb, A., Dor, P, Langer, R., Polyanhydride microspheres as drug carriers. II: Microencapsulation by solvent removal. J. Appl. Polym. Sci., 35: 755-774, 1988.
188. Chasin, M., Lewis, D., Langer, R. Polyanhydrides for controlled release. Biopharm. Manuf., 1: 33-46, 1988.
189. Brem, H., Kader, A., Epstein, J., Tamargo, R., Domb, A., Langer, R., Leong, K. Biocompatibility of a biodegradable controlled-release polymer in the rabbit brain. Selective Cancer Therap., 5: 55-65, 1989.
190. Levy, D., Kost, J., Meshulam, Y., Langer, R. Effect of ultrasound on transdermal drug delivery to rats and guinea pigs. J. Clin. Invest., 83: 2074-2078, 1989
191. Siegel, R., Kost, J., Langer, R. Mechanistic studies of macromolecular drug release from macroporous polymers. I. experiments and preliminary theory concerning completeness of drug release. J. Cont. Rel., 8: 223-236, 1989
192. Howard, M., Gross, A., Grady, M., Langer, R., Mathiowitz, E., Winn, R., Mayberg, M. Intracerebral drug delivery in rats with lesion-induced memory deficits. J. Neurosurgery, 71: 105-112, 1989.
193. Cima, L., Mooney, D., Vacanti, JP., Langer, R., Three dimensional culture of primary mammalian cells in porous biodegradable polymer matrices for *in vivo* organ regeneration. American Institute of Chemical Engineers. Microfiche Proceedings of Annual Conference, 1989.
194. Domb, A., Gallardo, C., Langer, R. Poly(anhydrides) 3. Poly(anhydrides) based on aliphaticaromatic diacids. Macromolecules, 22: 3200-3204, 1989.
195. Yu, H., Langer, R. Pseudopoly(amino acids): A study of the synthesis and characterization of poly(acyl-hydroxyproline-esters). Macromolecules, 22: 3250-3255, 1989.
196. Langer, R., Biomaterials in controlled drug delivery: New perspectives from biotechnological advances. Pharm. Techn., 13: 22-30, 1989.
197. Domb, A, Langer, R. Solid state and solution stability of poly(anhydrides) and poly(esters). Macromolecules, 22: 2117-2122, 1989
198. Kost, J., Leong, K., Langer, R. Ultrasound-enhanced polymer degradation and release of incorporated substances. PNAS 86: 7663-7666, 1989.
199. Comfort, A., Berkowitz, S., Albert, E., Langer, R. Immobilized enzyme cellulose hollow fibers: I. immobilization of heparinase. Biotech. Bioeng., 34: 1366-1373, 1989
200. Comfort, A., Albert, E., Langer, R. Immobilized enzyme cellulose hollow fibers: II. kinetic analysis. Biotech. Bioeng., 34: 1374-1382, 1989
201. Comfort, A., Berkowitz, S., Albert, E., Langer, R. Immobilized enzyme cellulose hollow fibers: III. physical properties and *in vitro* biocompatibility. Biotech. Bioeng., 34: 1383-1390, 1989.
202. Mullon, C., Tosone, C., Langer, R. Simulation of bilirubin detoxification in the newborn using an extracorporeal bilirubin oxidase reactor. Pediatric Res., 26: 452-457, 1989.
203. Yang, V., Bernstein, H., Langer, R. Heparinase immobilization, in Enzyme Engin. 9: 515-520, 1989.
204. Saltzman, W. Langer, R. Transport rates of proteins in porous materials with known microgeometry. Biophys. J., 55: 163-171, 1989.
205. Freese, A., Sabel, B., Saltzman, W., During, M., Langer, R. Controlled release of dopamine from a polymeric brain implant: *in vitro* characterization. Exp. Neur., 103: 234-238, 1989.
206. During, M., Freese, A., Sabel, B., Saltzman, W., Deutch, A., Roth, R., Langer, R. Controlled release of dopamine from a polymeric brain implant: *in vivo* characterization. Ann. Neur., 25: 351-356, 1989.
207. Mathiowitz, E., Kline, D., Langer, R. Morphology of Poly(anhydride) Microsphere delivery systems. J. Scanning Microscopy, 4: 329-340, 1990.
208. Staubli, A., Ron, E., Langer, R. Hydrolytically degradable amino acid containing polymers. J. Am. Chem. Soc., 112: 4419-4424, 1990.
209. Kibat, P., Igari, Y., Wheatley, M., Eisen, H., Langer, R. Microencapsulated liposomes: a system for enzymatically controlled pulsatile release of biologically active substances. FASEB J., 4: 2533-2539, 1990.
210. Moses, M., Sudhalter, J., Langer, R. Identification of an inhibitor of neovascularization from cartilage. Science, 248: 1408 - 1410, 1990.

211. Langer, R., Bernstein, H., Brown, L., Cima, L. Medical reactors. Chemical Eng. Sci., 45: 1967- 1978, 1990.
212. Mathiowitz, E., Ron, E., Mathiowtiz, G., Amato, C., Langer, R. Morphological characterization of bioerodible polymers. I. crystallinity of poly(anhydride) copolymers. Macromolecules, 23: 3212-3218, 1 990.
213. Kost, J., Langer, R. Magnetically and ultrasonically modulated drug delivery systems, in Pulsed and Self-Regulated Drug Del., (ea. J. Kost, CRC Press, Boca Raton, FL), pp. 3-16, 1990.
214. Ghodsian, F., Brown, L., Langer, R. Solubility dependent controlled release systems, in Pulsed and Self-Regulated Drug Del., (ea. J. Kost, CRC Press, Boca Raton, FL), pp. 201-214, 1990.
215. Laurencin, C., Pierre-Jacques, H., Langer, R. Toxicology and Biocompatibility Considerations in the Eval. of Polymeric Mat. for Biomed. Appl., Clinics in Lab. Med., 10: 549-570, 1 990.
216. Chasin, M., Domb, A., Ron, E., Mathiowitz, E., Leong, K., Laurencin, C., Brem, H., Grossman, B., Langer, R. Polyanhydrides as Drug Delivery Systems, in Biodegradable Polym. as Drug Del. Sys., 1990, 43-70. Eds., R. Langer, M. Chasin, Marcel Dekker Inc., NY.
217. Aiken, J., Cima, L., Schloo, B., Mooney, D., Johnson, L., Langer, R., Vacanti, J. Studies in Rat Liver Perfusion for Optimal Harvest of Hepatocytes. J. Ped. Surg., 25: 140-145, 1990.
218. Lucas, P., Laurencin, C., Syftestad, G., Domb, A., Goldberg, V., Caplan, A., Langer, R. Ectopic Induction of Cartilage and Bone by Water-soluble Proteins from Bovine Bone using Polyanhydride Delivery Vehicle. J. Biomed. Mat. Res., 24: 901-911, 1990.
219. Langer, R. New methods of drug delivery. Science, 249: 1527-1533, 1990.
220. Cohen, S., Bano, M., Visscher, K., Chow, M., Allcock, H., Langer, R. Ionically crosslinkable polyphosphazene: a novel polymer for microencapsulation. J. Am. Chem. Soc. 112: 7832-7833, 1990.
221. Laurencin, C., Domb, A., Morris, C., Brown, V., Chasin, M., McConnell, R., Langer, N., Langer, R. Poly(anhydride) administration in high doses in vivo: studies of biocompatibility and toxicology. J. Biomed. Mat. Res. 1463-1481, 1990.
222. Mathiowitz, E., Dor, P., Amato, C., Langer, R. Polyanhydride microspheres as drug carriers III morphology and release characterization of microspheres made by solvent removal. Polymer, 31, 547556, 1990.
223. Siegel, R., Langer, R. Mechanistic studies of macromolecular drug release from macroporous polymers. II: models for the slow kinetics of drug release. J. Contr. Rel. 14: 153-168, 1990.
224. Langer, R., Cima, L., Tamada, J., Wintermantel, E. Future directions in biomaterials. Biomaterials, 11: 738-745, 1990.
225. Vacanti, J., Ingber, D., Cima, L., Stein, J., Gilbert, J., Johnson, L., Schloo, B., Langer, R., Hepatocyte tissue engineering using constructs of synthetic polymer networks and cultured cells. S, Bengmark, ed. HPB Surgery. A World J. of Hepatic, Pancreatic and Biliary Surgery. London: Harwood Academic Publishers: 185-188, 1990.
226. Chasin, M., Hollenbeck, G., Brem, H., Grossman, S., Colvin, M., Langer, R. Interstitial drug therapy for brain tumors: a case study. Drug. Dev. Ind. Pharm., 16: 2579-2594, 1990.
227. Igari, Y., Kibat, P., Langer, R. Optimization of a microencapsulated liposome system for enzymatically controlled release of macromolecules. J. Cont. Rel. 14: 263-267, 1990.
228. Langer, R. Novel drug delivery systems. Chem. in Britain, 26: 232-238, 1990.
229. Domb, A., Laurencin, C., Israeli, O., Gerhart, R., Langer, R. The formation of propylene fumarate oligomers for use in bioerodible bone cement composites. J. Poly. Sci., 28: 973-985, 1990.
230. Leong, K., Domb, A., Ron, E., Langer, R. Polyanhydrides, in Second Ed. of the Encycl. Poly. Sci. Eng., 648-665, 1990.
231. Langer, R. Pharmacology, in 1991 McGraw-Hill Yearbook of Sci. and Tech., McGraw Hill Publishing Co., NY pp. 299-301, 1991.
232. Kost, J., Langer, R. Responsive polymeric delivery systems Adv. Drug Del. Rev., 6: 19-50, 1991.
233. Davies, M., Khan, M., Domb, A., Langer, R., Watts, J., Paul, A. The analysis of the surface chemical structure of biomedical aliphatic polyanhydrides using XPS and ToF-SIMS. J. Applied Poly. Sci. 42: 1597-1605, 1991.
234. Langer, R. Polymeric delivery systems, in Targeting of Drugs: 2 Optimization Strategies, Gregoriadis, G., Allison, A., and Poste, G. eds., 165-174, 1991.
235. Ron, E., Mathiowitz, E., Mathiowitz, G., Domb, A., Langer, R., NMR characterization of erodible copolymers. Macromolecules, 24: 2278-2282, 1991.
236. Leckband, D., Langer, R. An approach for the stable immobilization of proteins. Biotech. Bioeng., 37: 227- 237, 1991.

237. Cima, L., Ingber, D., Vacanti, J., Langer, R. Hepatocyte culture on biodegradable polymeric substrates. Biotech. Bioeng., 38: 145-158, 1991.
238. Moses, M. and Langer, R., Biocompatible controlled release polymers for delivery systems of polypeptides and growth factors. J. Cell. Biochem. 45: 340-345, 1991.
239. Staubli, A., Mathiowitz, E., and Langer, R., Characterization of hydrolytically degradable amino acid containing poly(anhydride-co-imides). Macromolecules, 24: 2283-2290, 1991.
240. Staubli, A., Mathiowitz, E., Langer, R., Sequence distribution and its effect on glass transition temperature of poly(anhydride-co-amides) containing asymmetric monomers. Macromolecules, 24: 2291-2298, 1991.
241. Cima, L., Vacanti, J., Vacanti, C., Ingber, D., Mooney, D., Langer, R., Tissue engineering by cell transplantation using degradable polymer substrate. J. Biomech. Eng., 113: 143-151, 1991.
242. Cohen, S., Bano, M., Chow, M., Langer, R. Lipid-alginate interactions render changes in phospholipid bilayer Permeability. Biochim. Biophys. Acta., 1063: 95-102, 1991.
243. Bano, M., Cohen, S., Visscher, K., Allcock, H., Langer, R. A Novel Synthetic Method for Hybridoma Cell Encapsulation. Bio/Tech., 9: 468-471, 1991.
244. Cohen, S., Yoshioka, T., Lucarelli, M., Hwang, L., Langer, R. Controlled Delivery Systems for proteins based on poly(Lactic/Glycolic Acid) Microspheres, Pharm. Res., 8: 713-720, 1991
245. Langer, R., Polymer implants for drug delivery in the brain. J. Cont. Rel., 16: 53-60, 1991.
246. Mikos, A., Mathiowitz, E., Langer, R. Peppas, N., The interaction of Polymer microspheres with Mucin Gels as a Means of characterizing polymer retention on Mucus. J. Colloid Inter. Sci., 143: 366-373, 1991.
247. Moses, M., Langer, R. Inhibitors of Angiogenesis. Bio/Technology, 9: 630-634, 1991.
248. Ron, E., Langer, R. Erodible systems, in Treatise on Cont. Drug Del. A. Kydonieus, ed. Marcel Dekker, Inc., pp. 199-224, 1991.
249. Edelman, E., Mathiowitz, E., Langer, R., Klagsbrun, M. Controlled and Modulated Release of Basic Fibroblast Growth Factor. Biomaterials, 12: 619-626, 1991.
250. Sluzky, V. Tamada, J.A., Klibanov, A., Langer, R. Kinetics of Insulin Aggregation in Aqueous Solutions upon Agitation in the Presence of Hydrophobic Surfaces. PNAS, 88: 9377-9381, 1991.
251. Madrid, Y., Brem, H., Langer, R. New Directions in the Delivery of Drugs and Other Substances to the Central Nervous System, in Adv. in Pharm., 22: 299-324, Academic Press, San Diego, CA, 1991.
252. Wheatley, M., Chang, M., Park, E., Langer, R. Coated Alginate Microspheres: Factors Influencing the Controlled Delivery of Macromolecules. J. Appl. Poly. Sci. 43: 2123-2135, 1991.
253. Wintermantel, E., Cima, L., Schloo, B., Langer, R. Angiopolarity: a new design parameter for cell transplantation devices and its application to degradable systems. ASAIO Trans., 37: m334-m336, 1991.
254. Zimmerman, J., Langer, R., Cooney, C. The release of heparinase from the Periplasmic space of flavobacterium heparinum by Three Step Osmotic Shock. Appl. Biochem. and Biotech., 30: 137-148, 1991.
255. Moses, M., Langer, R. A metalloproteinase Inhibitor as an Inhibitor of Neovascularization. J. Cell. Biochem. 47: 230-235, 1991
256. Langer, L., Brem, H., Langer, R. New technologies for fighting Brain Disease. Tech. Rev., 94: 62-71, 1991.
257. Liu, R., Klibanov, A., Langer, R. Moisture-Induced Aggregation of Lyophilized Proteins in the Solid State. Biotech. Bioeng. 37: 177-184, 1991.
258. Langer, R., Kost, J., Real Time Response polymeric delivery systems in Temporal Control of Drug Delivery, W. Hrushevsky, R. Langer, F. Theeuwes, eds., Annals of the New York Academy of Sciences, 618: 330-334, 1991.
259. Cohen, S., Bernstein, H., Hewes, C., Chow, M., Langer, R. The Pharmacokinetics of and humoral responses to antigen delivered by microencapsulated Liposomes. PNAS, 88: 10440-10444, 1991.
260. Vacanti, C., Langer, R., Schloo, B., Vacanti, J. Synthetic Polymers Seeded with Chondrocytes Provide a Template for New Cartilage Formation. J. Plastic Surg., 88: 753-759, 1991.
261. Tudor, A., Church, S., Domb, A., Hendra, P., Langer, R., Celia, C., Davies, M. The Application of Fourier-Transform Raman Spectroscopy to the Analysis of Poly(Anhydride) Homo and Co-Polymers. Spectrochimica Act., 47A: 1335- 1343, 1991.
262. Langer, R. Drug delivery systems. Mat. Res. Bulletin, Materials Research Society, 1: 47-49, 1991.
263. Cima, L., Langer, R., Vacanti, J. Polymers for tissue and Organ culture. J. Bioactive and Compatible Poly., 6: 232-239, 1991.
264. Domb, A., Mathiowitz, E., Ron, E., Giannos, S., Langer, R. Polyanhydrides IV: Unsaturated and cross- Linked Polyanhydrides. J. Poly. Sci., 29: 571-579, 1991.

265. Volkin, D., Staubli, A., Langer, R., Klibanov, A. Enzyme Thermoinactivation in AnLydrous Organic Solvents. Biotech. Bioeng., 37: 843-853, 1991.
266. Freed, L., Vunjak-Novakovic, G., Obradovic, B., Drinker, P., Langer, R. A bioreactor for blood detoxification: fluid dynamic and *ex vivo* modeling Studies. Macroscopic & Microscopic Heat & Mass Transfer in Biomed. Eng., 55-66, 1991.
267. Park, T., Cohen, S., Langer, R. Poly(L-lactic acid)/Pluronic Blends: Characterization of Phase Separation Behavior, degradation, Morphology and as Protein Releasing Matrices. Macromolecules, 25: 116-122, 1992.
268. During, M., Freese, A., Deutch, A., Kibat, P., Sabel, B., Langer, R., Roth, R. Biochemical and Behavioral Recovery in a Rodent Model of Parkinson's Disease following Stereotactic Implantation of dopamine-Containing Liposomes. Exper. Neurology, 115: 193-199, 1992.
269. Mathiowitz, E., Bernstein, H., Giannos, S., Dor, P., Turek, T., Langer, R. Polyanhydride Microspheres. IV. Morphology and characterization of systems made by spray drying. J. Applied Polym. Sci., 45: 125-134, 1992.
270. Alonso, M., Langer, R. Biodegradable controlled release microspheres for macromolecules and proteins, Profiles on Biotech., T.G. Villa, J. Abalde, Eds, in Servicio de Publicacions, Universidad de Santiango, 555-564, 1992.
271. Cady, S., Langer, R. Overview of protein formulations for animal health applications. J. Agric. and Food Chem., 40: 332-336, 1992.
272. Park, T., Cohen, S., Langer, R. Controlled protein release from polyethyleneimine coated poly(lactic acid)/pluronic blend matrices. Pharm. Res. 9: 37-39, 1992.
273. Mooney, D., Hansen, L., Vacanti, J., Langer, R., Farmer, S., Ingber, D. Different extracellular matrix molecules share a common mechanism for control of hepatocyte growth and differentiation. J. Cell Physiol., 3: 315-353, 1992.
274. Langer, R., Peppas N. New drug delivery systems. Bioeng. Sci. News, 16: 3-7, 1992.
275. Liu, L., Kost, J., D'Emanuele, A., Langer, R. Experimental approach to elucidate the mechanism of ultrasound-enhanced polymer erosion and release of incorporated substances. Macromolecules, 25: 123-128, 1992.
276. Kost, J., Langer, R., Responsive polymer systems for controlled delivery of therapeutics. Trends in Biotech., 10: 127-131, 1992.
277. Mooney, D.J., Johnson, L., Cima, L., Hansen, L., Ingber, D., Langer, R., Vacanti, J. Principles of tissue engineering and reconstruction using polymer-cell constructs, in Tissue-Inducing Biomat. 1992, 252: 345-352. Pittsburgh, PA: Cima, L., Ron, E., eds. Materials Research Society.
278. Mooney, D., Langer, R, Hansen, L., Vacanti, J., Ingber, D. Induction of hepatocyte differentiation by the extracellular matrix and an RGD-containing synthetic peptide, in Tissue-Inducing Biomat., 1992, 252: 199-204. Pittsburgh, PA: Cima, L., Ron, E., eds. Materials Research Society.
279. Tamada, J., Langer, R. The development of polyanhydrides for drug delivery applications. J. Biomat. Sci. Poly. Ed., 3: 315-353, 1992.
280. Sheppard, N., Madrid, M., Langer, R. Polymer matrix controlled release systems: influence of polymer carrier and temperature on water uptake and protein release. J. Appl. Polym. Sci., 46: 19-26, 1992.
281. Simons, M., Edelman, E., DeKeyser, J, Langer, R., Rosenberg, R. Antisense c-myb oligonucleotides Inhibit arterial smooth muscle proliferation *in vivo*. Nature, 359: 67-70, 1992.
282. Soltys, P., Mullon, C., Langer, R. Oral treatment for jaundice using immobilized bilirubin oxidase. Artificial Organs 16: 331-335, 1992.
283. Moses, M., Sudhalter, J., Langer, R. Isolation and characterization of an inhibitor of neovascularization for the conditioned media of scapular chondrocytes. J. Cell Biol., 119: 475-482, 1992
284. Edelman, E., Fiorino, A., Grodzinsky, A., Langer, R. Mechanical deformation of polymer matrix controlled release devices modulates drug release. J. Biomed. Mat. Res. 26: 1619, 1992.
285. Sluzky, V., Klibanov, A., Langer, R. Mechanism of insulin Aggregation and Stabilization, in Agitated Aqueous Solutions, Biotech., and Bioeng., 40: 895-903, 1992.
286. Shefer, S., Shefer, A., Kost, J., Langer, R. Structural characterization of starch networks in the solid state by cross-polarization magic-angle-spinning 13C-NMR spectroscopy and wide angle x-ray diffraction. Macromolecules, 25: 6756-6760, 1992.
287. Mooney, D., Hansen, L., Vacanti, J., Langer, R., Farmer, S., Ingber., D. Switching from differentiation to growth in hepatocytes: Control by extracellular matrix. J. Cell Physiol. 151: 497-505, 1992.
288. Mathiowitz, E., Langer, R., Polyanhydride Microspheres as Drug Delivery Systems, in Microcapsules in Med. and Pharm., M. Donbrow, ed, pp. 100-123, 1992.

289. D'Emanuele, A., Kost, J., Hill, J., Langer, R. An Investigation of the Effects of Ultrasound on Degradable Polyanhydride Matrices. Macromolecules, 25: 511-515, 1992.
290. Sheppard, N., Langer, R. The Use of Ultrasound Attenuation to Characterize Release of Proteins from Polymer Matrix Devices. J. Cont. Rel., 22: 245-242, 1992.
291. Cohen, S., Allcock, H., Langer, R. Cell and Enzyme Ionotropic Synthetic Hydrogels, in Recent Adv. in Pharm. and Indust. Biotech., 1992, 3648, Hincal, A., Kas, H., eds. Ankara.
292. Wintermantel, E., Cima, L., Schloo, B., Langer, R. Angiopolarity of cell carriers: directional angiogenesis in resorbable liver cell transplantation devices, in Angiogenesis: Key Principles- Science Technology, Medicine, 1992, 331-334, R. Steimer, P. Weisz, R. Langer, eds., Birkhauser, Basel.
293. Freed, L., Vunjak-Novakovic, G., Bernstein, H., Cooney, C., Langer, R. The Kinetics of Immobilized Heparinase in Human Blood. Annals of Biomed. Eng., 21: 67-76, 1993.
294. Mikos, A., Bao, Y., Ingber, D., Vacanti, J. Langer, R. Preparation of poly(glycolic acid) bonded fiber structures for cell transplantation. J. Biomed. Med. Res., 27: 183-189, 1993.
295. Tamada, J., Langer, R. Erosion Kinetics of Hydrolytically Degradable Polymers. PNAS, 90: 552-556, 1993.
296. Gross, A., Langer, R., Mathiowitz, E., Mayberg, M. Sustained Release of Acetylcholine in Rat Hippocampus Using a Polyanhydride Drug Delivery System. Poly. for Adv. Tech., 3: 331-335, 1993.
297. Freed, L., Marquis, J., Nohria, A., Mikos, A., Emmanual, J., Langer, R. Neocartilage formation *in vitro* and *in vivo* using cells cultured on synthetic biodegradable polymers. J. Biomed. Mat. Res. 27: 11-23, 1993.
298. Shefer, S., Ferreira, J., Mullon, C., Langer, R. Extracorporeal enzymatic removal of low density lipoproteins in rabitts: Efficacy and safety, The Inter. J. Artif. Organs, 16: 115-125, 1993.
299. Wald, H.L., Sarakinos, G., Mikos, A., Vacanti, J., Langer, R. Cell seeding in porous transplantation devices Biomaterials, 14: 270-278, 1993.
300. Tabata, Y., Langer, R., Polyanhydride microspheres that display near-constant release of water soluble drugs. Pharm. Res., 10: 391-399, 1993.
301. Tabata, Y., Gutta, S., Langer, R. Controlled delivery systems for proteins using polyanhydride microspheres. Pharm. Res., 10: 487-496, 1993.
302. Brem, H., Walter, K., Langer, R. Polymers as controlled drug delivery devices for the treatment of malignant brain tumors, Eur. J. Pharm. and Biopharm., 39: 2-7, 1993.
303. Mikos, A., Sarakinos, G., Leite, S., Vacanti, J., Langer, R. Laminated three-dimensional biodegradable foams for use in tissue engineering, Biomaterials, 14: 323-330, 1993.
304. Sasisekharan, R., Bulmer, M., Moremen, K.W., Cooney, C., Langer, R. Cloning and expression of heparinase I gene from *flavobacterium heparinum.* PNAS, 90: 3660-3664, 1993.
305. Gilbert, J., Takeda, T., Stein, J., Langer, R., Vacanti, J., Cell Transplantation of Genetically Altered Cells on Biodegradable Polymer Scaffolds in Syngeneic Rats. Transplantation. Vol. 56, No. 2: 423-427, 1993.
306. Labeque, R., Mullon, C., Ferreira, J., Lees, R., Langer, R. Enzymatic modification of plasma low density dipoproteins: a potential treatment for hypercholesterolemia. PNAS, 90: 3476-3480, 1993.
307. Laurencin, C., Gerhart, T., Witschger, P., Satcher, R., Domb, A., Hanff, P., Edsberg, L., Hayes, W., Langer, R. Bioerodible poly(anhydrides) for antibiotic drug delivery: *in vivo* osteomyelitis treatment in a rat model system. J. Orthoped. Res., 11: 256-262, 1993.
308. Ron, E., Turek, T., Mathiowitz, E., Chasin, M., Hageman, M., Langer, R. The Controlled Release of Polypeptides from Polyanhydrides. PNAS, 90: 4176-4180, 1993.
309. Fontaine, M., Hansen L., Thompson, S., Uyama S., Ingber, D., Mulligan, R., Langer, R., Vacanti, J. Transplantation of genetically altered hepatocytes using cell-polymer constructs leads to sustained human growth hormone secretion *in vivo.* Transplant. Proc. 25: 1002-1004, 1993.
310. Langer, R. and Vacanti, J., Tissue engineering, Science, 260: 920-926, 1993.
311. Bhagat, H., Langer, R., Implants and Implantation Technology, in Encyclopedia of Pharm. Tech., 1993, 8: 53-82, J. Swarbrick, J. Boylan, eds., , Marcel Dekker,.
312. Gupta, R., Siber, G., Alonso, M., Langer, R. Development of a Single-dose tetanus toxoid based on controlled release from biodegradable and biocompatible polyester microspheres, in Vaccines 93: 391-396, 1993, Cold Spring Harbor, NY.
313. Cima, L., Langer, R. Engineering Human Tissue. Chem Eng. Progress, 6: 46-54, 1993.
314. Prausnitz, M., Lau, B., Milano, C., Conner, S., Langer, R., Weaver, J. A quantitative study of electroporation showing a plateau in net molecular transport. Biophys. J., 65414-422, 1993.

315. Edelman, E., Langer, R. Optimization of release from magnetically controlled polymeric drug release devices. Biomaterials, 14: 8, 621-626, 1993.
316. Prausnitz, M., Bose, V., Langer, R., Weaver, J. Transtissue Molecular Transport Due to Electroporation of Skin, in Electricity and Magnetism in Bio. and Med., M. Blank, ed. San Francisco Press, San Francisco, CA, 122-124, 1993.
317. Lau, B., Milano, C., Prausnitz, M., Langer, R., Weaver, J. Quantitative Determination of Molecular Transport Across Erythrocyte Ghost Membranes by Electroporation, in Electricity and Magnetism in Bio. and Med., M. Blank, ed. San Francisco Press, San Francisco, CA, 141-143, 1993.
318. Mikos, A., Sarakinos, G., Leite, S., Vacanti, J., Langer, R., Preparation of Poly(glycolic acid) Bonded Fiber Structures for Cell Attachment and Transplantation. J. Biomed. Mater. Res. Vol. 27, No. 2: 183-189, 1993
319. Mikos, A., Sarakinos, G., Leite, S., Vacanti, J., Langer, R., Laminated Three Dimensional Biodegradable Foams for use in Tissue Engineering. Biomaterials. Vol. 14, No. 5: 323-330, 1993.
320. Alonso, M., Cohen, S., Park, T., Gupta, R., Siber, G., Langer R. Determinants of release rate of tetanus vaccine from polyester microspheres. Pharm Res., 10: 945-953, 1993.
321. Goepferich, A., Langer, R. The influence of microstructure and monomer properties on the erosion mechanism of a class of polyanhydrides. J. Poly. Sci. 31: 2445-2458, 1993.
322. Goepferich, A., Langer, R. Modeling of Polymer Erosion. Macromolecules, 22: 4105-4112, 1993.
323. Mikos, A., Sarakinos, G., Lyman, M., Ingber D., Vacanti, J., Langer, R. Prevascularization of biodegradable polymer scaffolds for hepatocyte transplantation. Biotech. & Bioeng. 42: 716-723, 1993.
324. Ferreira, J., Sasisikharan, R., Louie, O., Langer, R. Influence of chemistry in immobilization of cobra venom phospholipase A2 - Implications as to mechanism. Biochemistry, 32: 8098-8102, 1993.
325. Masters, D., Berde, C., Dutta, S., Turek, T., Langer, R. Sustained local anesthetic release from bioerodible polymer matrices: A potential method for prolonged regional anesthesia. Pharm. Res., 10: 1527-1532, 1993.
326. Masters, D., Berde, C., Dutta, S., Griggs, C., Hu, D., Kupsky, W., Langer, R. Prolonged Regional Nerve Blockage by Controlled Release of Local Anesthetic from a Biodegradable Polymer Matrix. Anesthesiology, 79: 340-346, 1993.
327. Andrianov, A., Cohen, S., Visscher, K., Payne L., Allcock, H., Langer, R. Controlled Release Using Ionotropic Polyposphazene Hydrogels. J. Contr. Rel., 27: 69-77, 1993.
328. Langer, R., Polymer Controlled Drug Delivery Systems. Accts. of Chem. Res., 26: 537-542, 1993.
329. Shefer, S., Payne, R., Langer, R. Design of a biomedical reactor for plasma Low Density Lipoprotein removal. Biotech. and Bioeng., 42: 1252-1262, 1993.
330. Barrera, D., Zylstra, E., Lansbury, P., Langer, R. Synthesis and RGD Peptide Modification of a New Biodegradable Copolymer System: Poly(Lactic Acid-co-Lysine). J. of Amer. Chem. Soc., 115: 11010-11011, 1993.
331. Prausnitz, M., Langer, Weaver, J. Electroporation of mammalian skin: A new mechanism to enhance transdermal drug delivery, PNAS 90: 10504-10508, 1993.
332. Prausnitz, M., Seddick, D., Kon, A., Bose, V., Frankenburg, S., Klaus, S., Langer, R., Weaver, J. Methods for *in vivo* tissue electroporation using surface electrodes. Drug Del., 1: 125-131, 1993.
333. Cohen, S., Bano, M., Cima, L., Allcock, H., Vacanti, J., Vacanti, C., Langer, R. Design of synthetic polymeric structures for cell transplantation and tissue engineering, Clinical Mat., 16: 310, 1993.
334. Gilbert, J., Takeda, T., Stein, J., Langer, R., Vacanti, J. Cell transplantation of genetically altered cells on biodegradable polymer scaffolds in syngeneic rats. Transplantation, 56: 423-427, 1993.
335. Kost, J., Langer, R. Ultrasound-mediated transdermal drug delivery, in Topical Drug Bioavailiability Bioequivalence. Penetration, Plenium Press, NY, V. Shah, H. Maibach, eds., 91-104, 1993.
336. Freed, L., Vunjak-Novakovic, G., Langer, R. Cultivation of cell-polymer cartilage implants in bioreactors. J. Cell. Biochem., 51: 257-64, 1993.
337. Freed, L., Vunjak-Novakovic, G., Drinker, P., Langer, R. A Bioreactor based on Suspended Particles of Immobilized Enzyme. Annals of Biomed. Eng. 21: 57-65, 1993.
338. Cleland, J., Langer, R. Formulation and delivery of proteins and peptides: Design and development strategies. ACS Symps. Ser. 567: 1-19, 1994.
339. Sasisekharan, R., Moses, M., Nugent, A., Cooney, C., Langer, R. Heparinase inhibits neovascularization. PNAS, 91: 1524-1528, 1994.
340. Wu, M., Tamada, J., Brem, H., Langer, R. *In vivo* versus *in vitro* degradation of controlled release polymers for intracranial surgical therapy. J. Biomed. Mat. Res., 28: 387-395, 1994.

341. Gref, R., Minamitake, Y., Peracchia, M., Trubetshoy, V. Torchillin, V., Langer, R. Biodegradable long- circulating polymeric nanospheres. Science, 263: 1600-1603, 1994.
342. Wong, J., Langer, R., Ingber, D. Novel applications for electrically conducting polymers: Control of cell shape on polypyrrole thin films. Proc. Nat. Acad. Sci., 91: 3201-3204, 1994.
343. Shieh, L., Tamada, J., Tabata, Y., Domb, A., Langer, R. Drug Release from a New Family of Biodegradable Polyanhydrides. J. Cont. Rel., 29: 73-82, 1994.
344. Freed, L., Vunjak-Novakovic, G., Marquis, J., Langer, R. Kinetics of Chondrocyte Growth in Cell- Polymer Implants. Biotech. Bioengin., 43: 597-604, 1994.
345. Alonso, M., Gupta, R., Min, C., Siber, G., Langer, R. Biodegradable Microspheres as Controlled Release Tetanus Toxoid Delivery Systems. Vaccine, 12: 299-306, 1994.
346. Freed, L., Marquis, J., Emmanual, J., Vunjak-Novakovic, G., Marquis, J., Langer, R. Composition of Cell-Polymer Cartilage Implants. Biotech. Bioeng., 43: 605-614, 1994.
347. Mikos, A., Freed, L., Langer, R., Wetting of poly(L-lactic acid) and poly(DL-lactic-co-glycolic acid) foams for tissue culture. Biomaterials, 15: 55-58, 1994.
348. Peppas, N., Langer, R., New Challenges in Biomaterials. Science, 263, 1715-1720, 1994.
349. Cohen, S., Langer, R., Pulsatile Liposomes. J. Liposome Res., 4: 349-360, 1994.
350. Mikos, A., Thorsen, A., Czerwonka, L., Bao, Y., Winslow, N., Vacanti, J., Langer, R. Preparation and Characterization of Poly(L-Lactic Acid) Foams for Cell Transplantation. Polymer, 35: 1068-1077, 1994.
351. Prausnitz, M., Milano, C., Gimm, J., Langer, R., Weaver, J. Quantitative Study of Molecular Transport Due to Electroporation: Uptake of Bovine Serum Albumin by Erythrocyte Ghosts. Biophys. J., 66: 1522-1530, 1994.
352. Tabata, Y., Langer, R. Polyanhydride Granules Provide Near-Constant Release of Water-Soluble Drugs. J. Pharm. Sci., 83: 5-11, 1994.
353. Freed, L., Grande, D., Emmanual, J., Kwan, M., Marquis, J., Lingbin, Z., Dunkelman, N., Langer, R. Joint Resurfacing Using Allograft Chondrocytes and Synthetic Biodegradable Polymer Scaffolds. J. Biomed. Mat. Res., 28: 891-899, 1994.
354. Freed, L., Vunjak-Novakovic, G., Biron, R., Eagles, D., Lesnoy, D., Barlow, S., Langer, R. Biodegradable Polymer Scaffolds for Tissue Engineering. Bio/Tech., 12: 689-693, 1994.
355. Kost, J., Liu, L.-S., Ferreira, J., Langer, R. Enhanced Protein Blotting from PhastGel Media to Membranes by Irradiation of Low Intensity Ultrasound. Anal. Biochem., 216: 27-32, 1994.
356. Venkataraman, G., Sasisekharan, V., Cooney, C., Langer, R., Sasisekharan, R. A Stereochemical approach to pyranose ring flexibility. Its implications on the conformation of dermatan sulfate. PNAS., 91: 6171-6175, 1994.
357. Kost, J., Liu, L., Gabelnick, H., Langer, R. Ultrasound as a Potential Trigger to Terminate the Activity of Contraceptive Delivery Implants. J. Cont. Rel., 30: 77-81, 1994.
358. Johnson, L., Aiken, J., Mooney, D., Schloo, B., Cima, L., Langer, R., Vacanti, J. The Mesentery as a Laminated Vascular Bed for Hepatocyte Transplantation. Cell Transpl., 3: 273-281, 1994.
359. Goepferich, A., Gref, R., Minamitake, Y., Shieh, L., Alonso, M., Tabata, Y., Langer, R. Drug Delivery from Bioerodible Polymers: Systemic and Intravenous Administration, in Formulation and Del. of Proteins and Peptides, ACS Press, Washington, D.C., ACS Symp. Series 567, J. Cleland, R. Langer, eds., 242-277, 1994.
360. Cohen, S. Langer, R. Inter and Intracellular Targeting of Drugs, in Adv. In Molec. And Cell Biol., CRC Press, Boca Raton, FL, B. Zetter, ed., 217-231, 1994.
361. Mooney, D., Mazzoni, C., Organ, G., Puelacher, W., Vacanti, J., Langer, R. Stabilizing fiber based cell delivery devices by physically bonding adjacent fibers. Mat. Res. Soc. Proc.: Biomat. for Drug and Cell Del., 331: 47-52, 1994.
362. Ferreira, J., Sasisekharan, R., Louie, O., Langer, R. A study on the functional sub-units of phospholipase A2 by enzyme immobilization. Biochem. J., 303: 527-530, 1994.
363. Puelacher, W., Mooney, D., Langer, R., Vacanti, J., Vacanti, C. Design of nasoseptal cartilage replacement synthesized from biodegradable polymers and chondrocytes. Biomaterials, 15: 774-778, 1994.
364. Ferreira, J., Sasisekharan, R., Louie, O., Langer, R. Carbodiimide Modification Enhances Activity of Pig Pancreatic Phospholipase A2. Eur. J. of Biochem., 223: 611-616, 1994.
365. Edwards, D., Langer, R. A linear theory of transdermal transport phenomena. J. Pharm. Sci., 83: 1315-1334, 1994.
366. Sakata, J., Vacanti, C., Schloo, B., Healy, G., Langer, R., Vacanti, J. Tracheal composite tissue engineered from chondrocytes, tracheal epithelial cells and synthetic degradable scaffolding. Transplant Proc., 26: 3309-3310, 1994.

367. Costantino, H., Langer, R., Klibanov, A. Solid-Phase Aggregation of Proteins under Pharmly Relevant Conditions. J. Pharm. Sci., 83: 1662-1666, 1994
368. Goepferich, A., Alonso, M., Langer, R., Development and characterization of microencapsulated microspheres. Pharm Res., 11: 1568- 1574, 1994.
369. Cohen, S., Langer, R. Novel Approaches to controlled release antigen delivery, in Internat. J. of Techn. Assessm. in Health Care A. Robbins, P. Freeman, eds. Cambridge University Press, 10:1, 121-130, 1994.
370. Rosenthal, R., Moses, M., Shintani, Y., Megyesi, J., Langer, R., Folkman, J. Purification and Characterization of a Mouse Sarcoma 180-Derived Collagenase Inhibitor which also Inhibits Endothelial Cell DNA Synthesis. J. Cell Biochem., 56: 97-105, 1994.
371. Park, T., Alonso, M., Langer, R. Controlled release of proteins from poly (L-lactic acid) coated poly (isobutylcyanoacrylate) microcapsules. J. Appl. Poly. Sci., 52: 1797-1807, 1994.
372. Andrianov, A., Payne, L., Visscher, K., Allcock, H., Langer, R. Hydrolytic degradation of tonically cross-linked polyphosphazene microspheres. J. Appl. Poly. Sci. 53: 1573-78, 1994.
373. Vacanti, C., Vacanti, J., Langer, R., Tissue Engineering Using Synthetic Biodegradable Polymers, in Poly. of Bio. and Biomed. Signif., ACS Symposium Series 540, Chicago, IL., 16-34, 1994.
374. Costantino, H., Langer, R., Klibanov, A., Moisture-Induced Aggregation of Lyophilized Insulin. Pharm. Res., 11: 21-29, 1994.
375. Prausnitz, M., Pliquett, U., Langer, R., Weaver, J. Rapid temporal control of transdermal drug delivery by electroporation. Pharm. Res., 11: 1834-1837, 1994.
376. Langer, R., Polymer systems for controlled release of macromolecules, immobilized enzyme medical bioreactors, and tissue engineering. Adv. in Chem. Eng., 19: 1-50, 1994.
377. Mooney, D., Organ, G., Vacanti, J., Langer, R., Design and fabrication of biodegradable polymer devices to engineer tubular tissues. Cell Transplant., 3: 203-210, 1994.
378. Brem, H., Walter, K., Tamargo, R. Olivi, A., Langer, R., Drug Delivery to the brain, in Poly. Site Spec. Pharm., 117-139, John Wiley & Sons, New York, 1994.
379. Takeda, T., Kim, T., Lee, S., Langer, R., Vacanti, J., Hepatocyte transplantation in biodegradable polymer scaffolds using the Dalmation dog model of hyperuricosuria. Transplant. Proc., 27: 635-636, 1994.
380. Shieh, L., Tamada, J., Chen, I., Pang, J., Domb, A., Langer, R., Erosion of a New Family of Biodegradable Polyanhydrides. J. Biomed. Mat. Res., 28: 1465-1475, 1994.
381. Mooney, D., Kaufmann, P., Sano, K., McNamara, K., Vacanti, J., Langer, R. Transplantation of hepatocytes using porous biodegradable sponges. Transplant. Proc., 26: 3425-26, 1994.
382. Puelacher, W., Mooney, D., Langer, R., Vacanti, J., Vacanti, C. Tissue engineered growth of cartilage: The effect of varying the concentration of chondrocytes seeded onto synthetic materials. Int. J. Oral Maxillofacial Surg., 23: 49-53, 1994.
383. Mooney, D., Hansen, L., Langer, R., Vacanti, J., Ingber, D. Extracellular matrix controls tubulin monomer levels by regulating protein turnover. Mol. Biol. Cell., 5: 1281-1288,1994.
384. Mooney, D., Park. S., Kaufmann, P., Sano, K., McNamara, K,. Vacanti, J., Langer, R. Biodegradable sponges for hepatocyte transplantation. J. Biomed. Mat. Res., 29: 959-966, 1994.
385. Mooney, D., Kaufmann, P., Sano, K., McNamara, K., Vacanti, J., Langer, R. Transplantation of Hepatocytes Using Porous, Biodegradable Sponges. Transplant. Proc., 26: 6, 3425-3426, 1994
386. Shefer, S., Breslau, J., Langer, R. Computer Simulation of LDL removal in the Presence of a Bioreactor Containing Phospholipase A2. Biotech. Prog.. 11: 133-139, 1995.
387. Hubbell, J., Langer, R., Tissue engineering. Chem. & Eng. News, 42-54, 1995.
388. Yaszemski, M., Payne, R., Hayes, W., Langer, R. Aufdemorte, T., Mikos, A. The ingrowth of new bone tissue and initial mechanical properties of a degrading polymeric composite scaffold. Tiss. Eng., 1: 41-45, 1995.
389. Mitragotri, S., Edwards, D., Blankschtein, D., Langer, R. A Mechanistic Study of Ultrasonically Enhanced Transdermal Drug Delivery. J. Pharm. Sci., 84: 697-706, 1995.
390. Goepferich, A., Langer, R. Modeling monomer release from bioerodible polymers. J. Cont. Rel., 33: 5569, 1995.
391. Uhrich, K., Gupta, A., Thomas, T., Laurencin, C., Langer, R. Synthesis and characterization of degradable poly(anhydride-co-imides). Macromolecules., 28: 2184-2193, 1995.
392. Mooney, D., Sano, K., Kaufmann, P., McNamara, K., Vacanti, J., Langer R., Integrating Cell Transplantation and Controlled Drug Delivery Technologies to Engineer Liver Tissue. Materials Research Society Proceedings, Vol. 394: 83-89, 1995

393. Cao, Y., Vacanti, J., Ma, P., Paige, K., Upton, J., Langer, R., Vacanti, C., Tissue Engineering of Tendon. Materials and Research Society Proceedings. Vol. 394: 91-97, 1995.
394. Edwards, D., Prauznitz, M., Langer, R., Weaver, J. Analysis of enhanced transdermal transport by skin electroporation. J. Cont. Rel., 34: 211-221, 1995.
395. Venkataraman, G., Sasisekharan, V., Cooney, C., Langer, R., Sasiskharan, R. Complex Flexibility of TGF-13 Super Family. PNAS 92: 5406-5410, 1995.
396. Mylonas, C., Tabata, Y., Langer, R., Zohar, Y. Preparation and evaluation of polyanhydride microspheres containing gonadotropin-releasing hormone (GnRH), for inducing ovulation and spermiation in fish. J. Cont. Rel. 35: 23-34, 1995.
397. Cohen, S., Langer, R. Long-term protein delivery from microencapsulated liposome systems, in Liposomes, New Sys. and New Trends in Their Appl., R. Puisieux, P. Couvreur, J. Delattre, J-P. Devissaguet, eds., Editions de Sante, Paris, France, 275-291, 1995.
398. Thomson, R., Ishaug, S., Mikos, A., Langer, R. Polymer for biological systems. The Encyclopedia of Molec. Biol. and Biotech. R. Meyer, ed. VCH Publishers, New York, NY, 717-724, 1995.
399. Ishaug, S.L., Thomson, R.C., Mikos, A., Langer, R. Biomaterials for organ regeneration. The Encyc. of Molec. Biol. and Biotech. R.A. Meyer, ed. VCH Publishers, NY, NY, pp. 86-93, 1995.
400. Hanes, J., Chiba, M., Langer, R. Polymer microspheres for vaccine delivery, in: Vaccine Design: The Subunit Approach, M. Powell, M. Newman, eds. 16: 389-412, Plenum, New York, 1995.
401. Cao, Y., Vacanti, J., Ma, X., Paige, K., Upton, J., Chowanski, Z., Schloo, B., Langer, R., Vacanti, C., Generation of neo-tendon using synthetic polymers seeded with tenocytes. Transplant. Proc. 26: 3390-3391, 1995.
402. Sakata, J., Vacanti, C., Schloo, B., Healy, G., Langer, R., Vacanti, J. Tracheal composites tissue engineered from chondrocytes, tracheal epithelial cells, and synthetic degradable scaffolding. Transplant. Proc. 26: 3309-3310, 1995.
403. Langer, R., Biomaterials: New Polymers and Novel Applications. MRS Bulletin, 20: 18-22, 1995.
404. Zewert, T., Pliquett, U., Langer, R., Weaver, J. Transdermal Transport of DNA Antisense Oligonucleotides by Electroporation. Biochem. and Biophys. Res. Comm., 212: 286-292, 1995.
405. Hrkach, J., Ou, J., Lotan, N., Langer, R. Synthesis of poly(λ-lactic acid-co -λ̃lysine) graft copolymers. Macromolecules, 28: 4736-4739, 1995.
406. Mitragotri, S., Blankschtein, D., Langer, R. Ultrasound-mediated transdermal protein delivery. Science, 269: 850-853, 1995.
407. Langer, R. and Vacanti, J. Artificial Organs. Sci. Amer., 273: 100-103, 1995.
408. Johnson, M., Blankschtein, D., Langer R., Permeation of steroids through human skin. J. Pharm. Sci., 84: 1144-1146, 1995
409. Langer, R., Vunjak, G., Freed, L., Atala, A., Vacanti, C., Vacanti, J., Tissue engineering: Biomedical applications. Tissue Engin., 1: 151-162, 1995.
410. Mooney, D., Breuer, C., McNamara, K, Vacanti, J., Langer R., Fabricating tubular devices from polymers of lactic and glycolic acid for tissue engineering. Tissue Engin., 1: 107-118, 1995.
411. Cohen, S., Langer, R. Novel liposome-based formulations for prolonged delivery of proteins and vaccines, J. Liposome Res., 5: 813-828, 1995.
412. Payne, L., Jenkins, S., Andrianov, A., Langer, R., Roberts, B. Xenobiotic Polymers as Vaccine Vehicles, in Adv. in Exper. Med. and Biol., 1995, 1475-1480, J. Mestecky et. al., eds., Plenum Press, NY
413. Okada, J., Cohen, S., Langer, R., *In vitro* evaluation of polymerized liposomes as an oral drug delivery system. Pharm. Res., 12: 4, 1-7, 1995.
414. Laurencin, C., Sobrasua, E., Ibim, M., Langer, R., Biomedical Applications of Synthetic Biodegradable Polymers, in CRC Press, J. Hollinger, ed., New York, pp. 59-102, 1995.
415. Shefer, S., Rosenberger, V., Vahanian, G., Wong, W., Langer, R., Implantable hollow fiber bioreactor as a potential treatment for hypercholesterolemia: characterization of the catalytic unit. Biotech & Bioeng, 48: 36-41, 1995.
416. Goepferich, A., Langer, R: Modeling of Polymer Erosion in Three Dimensions. AIChE J., 41: 289-299, 1995.
417. Prausnitz, M., Corbett, J., Gimm, J., Golan, D., Langer, R., Weaver, J., Millisecond measurement of transport during and after an electroporation pulse. Biophys. J., 68: 1864-1870, 1995.
418. Wake, M., Mikos, A., Sarakinos, G., Vacanti, J., Langer, R. Dynamics of fibrovascular tissue ingrowth in hydrogel foams. Cell Transplantation, 4: 275-279, 1995.

419. Langer, R., 1994 Whitaker Lecture: Polymers for drug delivery and tissue engineering. Annals of Biomed. Eng., 23: 101-111, 1995.
420. Ma, P., Schoo, B, Mooney, D., Langer, R., The development of biomechanical properties and morphogenesis of *in vitro* tissue engineered cartilage. J. Biomed. Mat. Res., 29: 1587-1595, 1995.
421. Schwendeman, S., Costantino, H., Gupta, R., Siber, G., Klibanov, A., Langer, R., Stabilization of tetanus and diptheria toxoids against moisture-induced aggregation. PNAS., 92: 11234- 11238, 1995.
422. Prausnitz, M., Edelman, E., Gimm, J., Langer, R., Weaver, J. Transdermal delivery of heparin by skin electroporation. Bio/Tech., 13: 1205-1209, 1995.
423. Ma, P., Langer, R., Degradation, structure and properties of fibrous nonwoven poly(glycolic acid) scaffolds for tissue engineering. Poly. in Med. Pham., Mikos, A., Leong, K., Radomsky, M., Tamada, J., Yaszemski, M., eds., 394: 99-104, 1995.
424. Shinoka, T., Breuer, C., Tanel, R., Zund, G., Miura, T., Ma, P., Langer, R., Vacanti, J., Mayer, J. Tissue engineering heart valves: valve leaflet replacement study in a lamb model. Annals of Thoracic Surg., 60: S513-516, 1995.
425. Costantino, H., Langer, R., Klibanov, A. Aggregation of a lyophilized pharm. protein, recombinant human albumin: effects of moisture and stabilization by excipients. Bio/Techn., 13: 493-496, 1995.
426. Weaver, J., Langer, R., Potts, R., Tissue electroporation for localized drug delivery, in Enviro. Elec. and Magnet. Fields, Blank, M., ed. American Chemical Society, 301-316, 1995.
427. Sasisekharan, R., Leckband, D., Godavarti, R., Venkataraman, G., Cooney, C., Langer, R., Heparinase I from flavobacterium heparinum: The role of cysteine residue in catalysis as probed by chemical modification and site-directed mutagenesis. Biochemistry, 34: 14441-14448, 1995.
428. Langer, R., Biomaterials and biomedical engineering. Chem. Eng. Sci. 50: 4109-4121, 1995.
429. Pliquett, W., Langer, R., Weaver, J. Changes in the passive electrical properties of human stratum corneum due to electroporation. Biochim. Biophys. Acta, 1239: 111-121, 1995.
430. Cusick, R., Sano, K., Lee, H., Pollok, J., Mooney, D., Langer, R., Vacanti, J. Heterotopic fetal rat hepatocyte transplantation on biodegradable polymers. Am. Coll. of Surgeons Surg. Forum, 46: 658-661, 1995.
431. Prausnitz, M., Bose, V., Langer, R., Weaver, J., Electroporation, in Percutaneous Penetration Enhancers, H. Maibach, E. Smith, eds., CRC Press, Boca Raton, FL, 393-405, 1995.
432. Costantino, H., Griebenow, K., Mishra, P., Langer, R., Klibanov, A. Fourier-transform infrared (FTIR) spectroscopic investigation of protein stability in the lyophilized form. Biochim. Biophys. Acta, 1253:69-74, 1995.
433. Ernst, S., Langer, R., Cooney, C., Sasisekharan, R. Enzymatic degradation of glycosaminoglycans. CRC Critical Rev. Biochem. Mol. Biol., 30: 387-444, 1995.
434. Mooney, D., Langer, R., Ingber, D. Cytoskeletal filament assembly and the control of cell shape and function by extracellular matrix. J. Cell Sci., 108: 2311-2320, 1995.
435. Barrera, D., Zylstra, E., Lansbury, P., Langer, R. Copolymerization and degradation of poly(lactic Langer, R., Polymers for Drug Delivery and Tissue Engineering. Macromolecules, 28: 425-432, 1995.
436. Hrkach, J., Ou, J., Lotan, N., Langer, R. Poly(L-Lactic acid-co-aspartic acid): Interactive polymers for tissue engineering. Mat. Res. Soc. Symp. Proc., 394: 77-82, 1995.
437. Goepferich, A., Karydas, D., Langer, R. Predicting drug release from cylindric polyanhydride matrix discs. European J. of Pharm. and Biopharm., 41(2): 81-87, 1995.
438. Mitragotri, S., Edwards, D., Blankschtein, D., Langer, R, Quantitative Prediction of Ultrasonically Enhanced Transdermal Drug Delivery, Proceed. Intern. Symp. Control. Rel. Bioact. Mater., 22, 1995.
439. Attawia, M., Uhrich, K., Botchwey, B., Fan, M., Laurencin, C., Langer, R. Cytotoxicity testing of poly(anhydride-co-imides) for orthopedic applications. J. Biomed. Mat. Res., 29, 1233-1240, 1995
440. Seidel, J., Uhrich, K., Laurencin, C., Langer, R., Erosion of Poly(anhydride-co-imides): A preliminary mechanistic study, Journal of Applied Polymer Sciences, 62 (8): 1277-1283, 1996
441. Mitragotri, S., Blankschtein, D., Langer, R. Transdermal drug delivery using low-frequency sonophoresis. Pharm. Res., 13: 411-420, 1996.
442. Breuer, C., Shinoka, T., Tanel, R., Zund, G., Mooney, D., Ma, P., Miura, T., Colan, S., Langer, R., Mayer, J., Vacanti, J. Tissue engineering lamb heart valve leaflets. Biotech and Bioeng., 50: 562-567, 1996
443. Vunjak-Novakovic, G., Freed, L., Biron, R., Langer, R. Effects of mixing on tissue engineered cartilage. Am. Inst. of Ch. Eng. J., 42: 850-860, 1996.

444. Hrkach, J., Peracchia, M., Domb, A., Lotan, N., Langer, R. Nanotechnology for biomaterials engineering: structural characterization of amphiphilic polymeric nanoparticles by 1H NMR spectroscopy. Biomaterials, 18: 27-30, 1996.
445. Uhrich, K.; Thomas, T.; Gupta, A.; Laurencin, C. Langer, R., *In vitro* degradation of poly(anhydride-imides) containing trimellitylimidoglycine. J. Appl. Polym. Sci., 34: 1261-69, 1996.
446. Attawia, M.; Uhrich, K.; Botchwey, E.; Langer, R., Laurencin, C., In vitro bone biocompatibility of poly(anhydride-co-imides) containing pyromellitylimidoalanine. J. Ortho. Res., 14: 445-454, 1996.
447. Curley, J., Castillo, J., Hotz, J., Uezono, M., Hernandez, S., Lim, J., Tigner, J., Chasin, M., Langer, R., Berde, C., Prolonged regional nerve blockade: injectable biodegradable bapivacaine-polyester microspheres. Anesthesiology, 84: 1401-1410, 1996.
448. Shastri, V., Schmidt, C, Kim, T., Vacanti, J., Langer, R., Polypyrrole: A potential candidate for stimulated nerve regeneration. Materials Research Society Proceedings. 414: 113-118, 1996
449. Vunjak-Novakovic, G., Freed, L., Langer, R., Culture de chondrocytes sur des polymeres biodegradables. Synoviale J. de Rhum., 12: 4-5, 1996.
450. Edwards, D., Gooch, K., Zhang, I., McKinley, G., Langer, R. The nucleation of receptor-mediated endocytosis. PNAS, 93: 1786-1791, 1996.
451. Sanchez, A., Gupta, R., Alonso, M., Siber, G., Langer, R. A pulsed controlled release system for potential use in vaccine delivery. J. Pharm. Sci., 85: 547-552, 1996.
452. Langer, R. Controlled release of a therapeutic protein. Nat. Med., 2: 742-743, 1996.
453. Mooney, D, Kaufman, P., Sano, K., Schwendeman, S., McNamara, K., Schloo, B., Vacanti, J., Langer, R. Localized delivery of epidermal growth factor improves the survival of transplanted hepatocytes. Biotech. and Bioeng., 50: 422-429, 1996.
454. Sano, K., Cusick, R., Lee, H., Pollok, J., Kaufmann, P., Uyama, S., Mooney, D., Langer, R., Vacanti, J., Regenerative signals for hetertopic hepatocyte transplantation. Trans. Proc., 28: 1857-1858, 1996.
455. Ibarra, C., Langer, R., Vacanti, J., Tissue engineering: cartilage, bone, and muscle, in Yearbook of Cell and Tiss. Trans. 1996/1997, 1996, 235-245, Lanza R., Chick W., eds. The Netherlands: Kluwer Academic Publishers.
456. Brem, H., Langer, R., Polymer-Based Drug Delivery to the Brain. Sci. Am.: Sci. and Med., 3: 52-61, 1996.
457. Johnson, M., Mitragotri, S., Patel, A., Blankschtein, D., Langer, R. Synergistic Effects of Chemical Enhancers and Therapeutic Ultrasound on Transdermal Drug Delivery. J. Pharm. Sci., 85: 7, 670-679, 1996.
458. Mooney, D., Mazzoni, C., Breuer, C., McNamara, K., Hern, D., Vacanti, J., Langer, R. Stabilized polyglycolic acid fiber-based devices for tissue engineering. Biomaterials, 17: 115-124, 1996.
459. Kost, J., Pliquett, U., Mitragotri, S., Yamamoto, A., Langer, R., Weaver, J., Synergistic Effect of Electric Field and Ultrasound on Transdermal Transport. Pharm. Res., 13: 4, 633-638, 1996.
460. Edwards, D., Schneck, F., Zhang, I., Davis, A., Chen. H., Langer, R. Spontaneous vesicle formation at lipid bilayer membranes. Biophys. J., 71: 1208-1214, 1996.
461. Schwendeman, S., Cardamone, M., Brandon, M., Klibanov, A., Langer, R., Stability of proteins and their delivery from biodegradable polymer microspheres, in Microspheres/ Microparticulates Charact. and Pharm. App., 1996, 1-49, H. Bernstein, S. Cohen, eds. Marcel Dekker, Inc., N.Y
462. Sasisekharan, R., Venkataraman, G., Godavarti, R., Ernst, S., Cooney, C., Langer, R. Heparinase I from Flavobacterium heparinum: The mapping and characterization of the heparin binding domain. J. Bio. Chem., 271: 3124-31, 1996.
463. Schwendeman, S., Costantino, H., Gupta, R., Tobio, M., Chang, A., Alonso, M., Siber, G., Langer, R. Strategies for stabilizing tetanus toxoid toward the development of a single-dose tetanus vaccine. Dev. in Bio. Standardization, 87: 293-306, 1996.
464. Li, W., Perzl, M., Heyder, J., Langer, R., Brain, J., Englemeir, K.H., Niven, R., Edwards, D. Aerodynamics and Aerosol Particle Deaggreation Phenomena in Model Oral-Pharyngeal Cavities. J. Aerosol Sci., 27, 1269-1286, 1996.
465. Langer, R., Polymeric drug delivery systems, in Idea to Product: The Process, Elsevier Publishers, N. Alexander, Wentz, A. eds., 53-67, 1996.
466. Venkataraman, G., Sasisekharan, V., Herr, A., Ornitz, D., Waksman, G., Cooney, C., Langer, R. Sasisekharan, R. Preferential self-association of fibroblast growth factor is stabilized by heparin during receptor dimerization and activation PNAS, 93: 845-50, 1996.

467. Ernst, S., Venkataraman, G., Winkler, S., Godavarti, R., Langer, R., Cooney, C., Sasisekharan, R. Expression in Escherichia coli, purification, and characterization of heparinase I from flavobacterium heparinum. Biochem. J., 315: 589-97, 1996.
468. Johnson, M., Berk, D., Blankschtein, D., Golan, D., Jain, R., Langer, R. Lateral diffusion of small compounds in human stratum corneum and model lipid bilayer systems. Biophvs. J., 71: 2656-2668, 1996.
469. Chen, H. and Langer, R. Polymerized liposomes as oral vaccine carriers: Stability and bioavailability. J. Cont. Rel., 42: 263-272, 1996.
470. Yaszemski, M., Payne, R,. Hayes, W., Langer, R., Mikos, A. Evolution of bone transplantation: molecular, cellular and tissue strategies to engineer human bone. Biomaterials, 17: 2, 175-185, 1996.
471. Mooney, D., Kim, B-S, Vacanti, J., Langer, R. Tissue engineering: Urogenital systems, in Textbook of Tissue Engineering. 1996, 587-596, Lanza, R., Chick, W., R. Langer, eds. Textbook of Tiss. Eng., Springer-Verlag, Berlin, Germany.
472. Pliquett, U., Zewert, T., Chen. T., Langer, R., Weaver, J. Imaging of fluorescent molecule and small ion transport through human stratum corneum during high-voltage pulsing: Localized transport regions are involved. J. Biophvs. Chem, 58: 185-204, 1996.
473. Prausnitz, M., Gimm, J., Weaver, J., Guy, R., Langer, R., Cullander, C. Imaging regions of transport across human stratum corneum during high-voltage and low-voltage exposures. J. Pharm. Sci. 85: 1363-1370, 1996.
474. Edelman, E., Brown, L., Langer, R. Quantification of insulin release from implantable polymer-based delivery systems and augmentation of therapeutic effect with simultaneous release of somatostatin, J. Pharm. Sci., 85: 1271 -75, 1996.
475. Brown, L., Edelman, E., Fischel-Ghodsian, F., Langer, R. Characterization of glucose-mediated insulin release from implantable polymers. J. Pharm. Sci., 85: 1341-45, 1996.
476. Costantino, H., Schwendeman, S., Griebenow, K., Klibanov, A., Langer, R. The Secondary Structure and Aggregation of Lyophilized Tetanus Toxoid. J. Pharm. Sci., 85: 1290-93, 1996.
477. Schwendeman, S., Costantino, H., Gupta, R., Langer, R. Progress and challenges for peptide, protein and vaccine delivery from implantable polymeric systems, in Cont. Drug Del.: The Next Generation, Park, K., ed., The American Chemical Society, Washington, 1996.
478. Kohn, J., Langer, R. Bioresorbable and bioerodible materials, in Bio. Sci., An Introduction to Materials in Medicine. Ratner, B., Hoffman, A., Schoen, F., Lemons, J., eds., 1996, 64-72, Academic Press, New York, NY.
479. Chen, H., Langer, R. Lectin-bearing polymerized liposomes as potential oral vaccine carriers. Pharm. Research, 13: 1378-1383, 1996.
480. Hanes, J., Langer, R., Polymeric controlled release vaccine delivery systems, in Reproductive Immunology, R. Bronson, N. Alexander, D. Anderson, D., Branch, Kutteh, W., eds., Blackwell Scientific Publications, Inc., Boston, 647-664, 1996.
481. Moses, M., Marikovsky, M. Harper, J., Vogt, P., Eriksson, E., Klagsbrun, M., Langer, R. Temporal study of the activity of matrix metalloproteinases and their endogenous inhibitors during wound healing, J. Cell. Biochem., 60: 379-386, 1996.
482. Prausnitz, M., Lee, C., Liu, C., Pang, J., Singh, T., Weaver, J., Langer, R. Transdermal transport efficiency during skin electroporation and iontophoresis. J. Contr. Rel., 38: 205-217, 1996.
483. Mooney, D., Baldwin, D., Suh, N., Vacanti, H., Langer, R., A novel approach to fabricate porous sponges of poly(D,L-lactic-co-glycolic acid) without the use of organic solvents. Biomaterials, 17: 1417-1422, 1996.
484. Hrkach, J., Ou, J., Lotan, N., Langer, R. Poly(λ-lactic acid-co-amino acid) graft copolymers: A class of functional, biodegradable biomaterials, in Hydrogels and Biodegrad. Poly. for Bioapp.; 1996, 8: 93-102, Ottenbrite, R., Huang, S., Park, K., eds. ACS Symposium Series 627; ACS: Washington, DC
485. Shinoka, T., Ma, P., Shum-Tim, D., Breuer, C., Cusick, R., Zund, G., Langer, R., Vacanti, J., Mayer, J., Tissue-engineered heart valves: autologous valve leaflet replacement study in a lamb model. Sup. II Circulation, 94: 164-168, 1996.
486. Kline, D.F., Hanes, J., Langer, R., Adjuvant-active polymeric microparticles vaccine-delivery systems, in: Microparticulate Systems for the Delivery of Proteins and Vaccines, Cohen, S., and Bernstein, H., eds., Marcel Dekker, Inc. ,New York, 349-380, (1996)
487. Hanes, J., Chiba, M., Langer, R., Synthesis and characterization of degradable (anhydride-co-imide) terpolymers containing trimellitylimido-L tyrosine: novel polymers for drug delivery. Macromolecules, 29: 5279-5287, 1996.

488. Cohen, S., Bano, M. Cima, L., Allcock, H., Vacanti, J., Vacanti, C., Langer, R. Design of synthetic polymeric structures for cell transplantation and tissue engineering. Clinic. Mat., 13: 3-10, 1996.
489. Castillo J., Curley, J., Hotz, J., Uezono M., Tigner, J., Chasin, M., Langer, R., Berde C. Glucocorticoids prolong rat sciatic nerve blockade in vivo from bupivacaine microspheres. Anesthesiology, 85: 1157-1166, 1996.
490. Godavarti, R., Cooney, C., Langer, R., Sasisekharan, R., Heparinase I from Flavohacterium heparinum, Identification of a critical histidine residue essential for catalysis as probed by chemical modification and site directed mutagenesis. Biochemistry, 35: 6846-6852, 1996.
491. Kost, J., Pliquet, U., Mitragotri, S., Yamamoto, A., Langer, R., Weaver, J., Synergistic Effect of Ultrasound and Electroporation on Transdermal Drug Delivery Proceed. Intern. Symp. Control. Rel. Bioact. Mater., 23, 1996.
492. Mitragotri, S., Blankschtein, D., Langer, R., Transdermal Drug Delivery Using Low-Frequency Sonophoresis, Pharmaceutical Research, 13: 3, 411-420, 1996.
493. Mitragotri, S., Blankschtein, D., Langer, R., Sonophoresis: Enhanced Transdermal Drug Delivery by Application of Ultrasound, Encl. Of Pharm. Tech., Swarbrick, J., Boylan, J., Eds., 14: 103-122, 1996.
494. Anseth, K., Shastri, V., Laurencin, C., Langer, R., Photo-polymerization of novel degradable networks for orthopaedic applications, ACS Polymer Materials Society Science Proceedings, 74: 385-386, 1996
495. Godavarti, R., Davis, M., Venkataraman, G., Conney, C., Langer, R., Sasisekharan, R., Cloning and recombinant expression of Heparinases I, II, and III from *flavobacterium heparinum*. Biochemistry and Biophysical Research Community, 225: 751-758, 1996.
496. Schwendeman, S., Costantino, H., Gupta, R., Klibanov, A., Langer, R. Peptide, protein and vaccine delivery from implantable polymer systems, in: Controlled Drug Del.: Challenges and Strategies, 1997, 229-267. K Park, ed., American Chemical Society, Washington, DC.
497. Costantino, H., Liauw, S., Mitragotri, S. Langer, R., Klibanov, A., Sluzky, V. The pharmaceutical development of insulin: Historical perspectives and future directions. ACS Symposium Series, in: Therapeutic Protein and Peptide Form. and Del., Shahrokh, Z., Sluzky, V., Cleland, J.., Shire, S., Randolph, T., Eds., American Chemical Society, Washington, DC, 29-66, 1997.
498. Peter, S., Yaszemski, M., Suggs, L., Payne, R., Langer, R., Hayes, W., Unroe, M., Alemany, L., Engel, P., Mikos, A. Characterization of partially saturated poly(propylene fumarate) for orthopaedic application. J. Biomater. Sci., 8: 893-904, 1997.
499. Langer, R. Tissue engineering: A new field and its challenges. Pharmaceutical Research, 14, 840-841, 1997.
500. Chaignaud B., Langer, R., Vacanti, J. History of tissue engineering with synthetic scaffolds, in Synth. Biodegradable Poly. Scaffolds, 1-14, Atala, A., Langer, R., Mooney, D., Vacanti, J., eds., Boston: Birkhauser, 1997.
501. Kim, T., Lee, H., Utsunomiya, H., Ma, P., Langer, R., Schmidt, E., Vacanti, J., Enhanced survival of transgenic hepocytes expressing hepatocyte growth factor in heptocyte tissue engineering. Transplant Prot. 29, 858-860, 1997.
502. Chen, H., Langer, R. Magnetically-responsive liposomes as potential oral delivery vehicles. Pharmaceutical Research, 14, 537-50, 1997.
503. Costantino, H., Griebenow, K., Langer, R., A. Klibanov. On the pH memory of lyophilized compounds containing protein functional groups. Biotechnology and Bioengineering. 53: 345-348, 1997.
504. Uhrich, K., Thomas, T., Laurencin, C., Langer, R. *In vitro* degradation characteristics of poly(anhydride imides) containing trimellitylimidoglycine. Journal of Applied Polymer Science, 63: 1401-1411, 1997.
505. Costantino, H., Shieh, L., Klibanov, A., Langer, R. Heterogeneity of serum albumin samples with respect to solid-state aggregation via thiol-disulfide interchange-Implications for sustained release from polymers. Journal of Controlled Release, 44: 255-261, 1997.
506. Shakesheff, K., Evora, C., Soriano, M., Langer, R. The adsorption of poly(vinyl alcohol) to biodegradable microparticles studied by x-ray photoelectron spectroscopy (XPS). Journal of Colloid and Interface Science, 185: 538-547, 1997.
507. Ernst, S., Garro, O., Winkler, S., Venkataraman, G., Langer, R., Cooney, L., Sasisekharan, R. Process simulation for recombinant protein production: Cost estimation and sensitivity analysis for heparinase I expressed in Escherichia coli. Biotechnology and Bioengineering 53: 575-582, 1997.
508. Cook, A., Hrkach, J., Gao, N., Johnson, I., Pajvani, U., Cannizzaro, S., Langer, R. Characterization and development of RGD-peptide-modified poly(lactic acid-co-lysine) as an interactive, resorbable biomaterial. Journal of Biomedical Materials Research, 35: 513-523, 1997.

509. Mader, K., Bacic, G., Domb, A., Elamalak, O, Langer, R., Swartz, H. Noninvasive *in vivo* monitoring of drug release and polymer erosion from biodegradable polymers by EPR spectroscopy and NMR imaging. Journal of Pharmaceutical Science, 86: 126-134, 1997.
510. Narasimhan, B., Langer, R. Zero-order release of micro- and macromolecules from polymeric devices: The role of the burst effect. Journal of Controlled Release, 47: 13-20, 1997.
511. Peracchia, M., Gref, R., Minamintake, Y., Domb, A, Lotan, N., Langer, R. PEG-coated nanospheres form amphiphilic diblock and multiblock copolymers: Investigation of their drug encapsulation and release characteristics. Journal of Controlled Release, 46: 223-231, 1997.
512. Elisseeff, J. Anseth, K, Langer, R., Hrkach, J. Synthesis and characterization of photocrosslinked polymers based on poly(L-lactic acid-co-L-aspartic acid). Macromolecules, 30: 2182-2184, 1997.
513. Edwards, D., Hanes, J., Caponetti, G., Hrkach, J., Ben-Jebria, A, Eskew, M., Mintzes, J. Deaver, D., Lotan, N., Langer, R. Large porous aerosols for pulmonary drug delivery. Science, 276: 1868-1871, 1997.
514. Chiba, M., Hanes, J., Langer, R. Controlled Protein Delivery from Biodegradable Tyrosine-Containing Poly(anhydride-co-imide) Microspheres. Biomaterials, 18: 893-901, 1997.
515. Zund, G., Breuer, C., Shinoka, T., Ma, P., Langer, R., Mayer J., Vacanti, J. A novel approach for construction of a bioprosthetic heart valve. Eur. J. Cardio-thoracic Surg., 11: 493-497, 1997.
516. Schmidt, C., Shastri, V., Vacanti, J., Langer, R. Stimulation of neurite outgrowth using an electrically conducting polymer. PNAS 94: 8948-8953, 1997.
517. Chen, H., Langer, R., Edwards, D. A film tension theory of phagocytosis. J. Colloid and Interfac. Sci., 190: 118-133, 1997.
518. Cook, A., Pajvani, U., Hrkach, J., Cannizzaro, S., Langer, R. Colorimetric analysis of surface reactive amino groups on poly(lactic acid-*co*-lysine): poly(lactic acids) blends. Biomaterials, 18: 1417-1424, 1997
519. Gupta, R., Alroy, J., Alonso, M., Langer, R., Siber, G. Chronic local tissue reactions, long term immunogenicity and immunologic priming of mice and guinea pigs to tetanus toxoid encapsulated in biodegradable polymer microspheres composed of poly lactide-co-glycolide polymers. Vaccine, 15: 1716-1723, 1997.
520. Cusick, R., Lee, H., Sano, K., Pollok, J., Utsunomiya, H, Ma, P., Langer, R., Vacanti, J. The effect of donor and recipient age on engraftment of tissue engineered liver. J. Pediatr. Surg., 32: 357-360, 1997.
521. Shinoka, T., Shum-Tim, S., Ma, P., Tanel, R., Langer, R., Vacanti, J., Mayer, J., Jr., Tissue-engineered heart valve leaflets. Does cell origin affect outcome? Circulation 1997; 96(suppl II): II-102-II-107.
522. Freed, L., Langer, R., Martin, I., Pellis, N., Vunjak-Novakovic, G. Tissue engineering of cartilage in space. PNAS, 94: 13885-13890, 1997.
523. Hanes, J., Cleland, J., Langer, R. New advances in microsphere-based single-dose vaccine. Adv. Drug Del. Rev., 28: 97-120, 1997.
524. Uhrich, K., Larrier, D., Laurencin, C., Langer, R. *In vitro* degradation characteristics of poly(anhydride imides) containing pyromellitylimidoalanine. J. Poly. Sci., 34: 1261-1269, 1997.
525. Mooney, D., Langer, R. Engineering biomaterials for tissue engineering to 10-100 micron scale, Bio. Engin. Handbook, Bronzino, J., ed., CRC Press, Boca Raton, FL, pp. 1609-1618, 1997.
526. Batycky, R., Hanes, J., Langer, R., Edwards, D. Theoretical model of erosion and macromolecular drug release from biodegrading microspheres. Journal of Pharmaceutical Science, 86: 1464-1477, 1997.
527. Mooney, D., Sano, K., Kaufmann, P., Majahod, K., Schloo, B., Vacanti, J., Langer, R. Long-term engraftment of hepatocytes transplanted on biodegradable polymer sponges. Journal of Biomedical Materials Research, 37: 413-420, 1997.
528. Johnson, M., Blankschtein, D., Langer, R. Evaluation of solute permeation through the stratum corneum: lateral bilayer diffusion as the primary transport mechanism. Journal of Pharmaceutical Science, 86: 1162-1172, 1997.
529. Mitragotri, S., Blankschtein, D., Langer, R. An explanation for the variation of the efficacy of sonophoresis from drug to drug. Journal of Pharmaceutical Science, 86: 1190-1192, 1997.
530. Niklason, L., Langer, R. Advances in tissue engineering of blood vessels and other tissues. Transplant Immun., 5: 303-306, 1997.
531. Constantino, R., Liauw, S., Mitragotri, S., Klibanov, A., Langer, R., Sluzky, V. Pharm. developments of insulin, in Therapeutic Protein and Peptide Form. and Del., ACS Symposium Series, Shahrokh, Z., Sluzky, V., Cleland, J., Shrine, S., Randolph, T., Eds., 29-66, 1997.
532. Shastri, V.R., Hildgen, P., Langer, R. Najajrah, Y., Ringel, I., Domb, A. Other polyesters, in Handbook of Biodegrad. Poly., A. Domb, J. Kost, D. Wiseman, eds. Harwood Academic Publishers, 119-134, (1997)

533. Domb, A., Elmalak, O., Shastri, V., Ta-Shma, Z., Masters, D., Ringel, I., Teomim, D., and Langer, R. Polyanhydrides, in Handbook of Biodegradable Poly. A. Domb, J. Kost, D. Wiseman, eds., Harwood Academic Publishers, 135-159, 1997
534. Mitragotri, S., Blankschtein, D., Langer, R., An Explanation for the Variation of the Sonophoretic Transdermal Transport Enhancement from Drug to Drug, Journal of Pharmaceutical Science, 86: 10, 1190-92, 1997.
535. Shastri, V., Tarcha, P., Padera, R., Langer, R., Biocompatibility of photo-cured polyanhydrides for orthopedic and dental applications, Proceeding of Surfaces in Biomaterials, 52-56, 1997.
536. Dillow, A., Dehghani, F., Foster, N., Hrkach, J., Langer, R., Production of polymeric support materials using a supercritical fluid gas anti-solvent process, ISSF Proceedings, A: 247-250, 1997.
537. Elisseeff J, McIntosh W, Langer R., Synthesis of succinic acid PEO hydrogels and their use as controlled release vehicles, Abs. of papers of the American Chemical Society, PMSE Part II, 213: 136, 1997.
538. Gao, J., Niklason, L., Zhao, X., Langer, R. Surface modification of polyanhydrides microsphere, Journal of Pharmaceutical Science, 87: 2, 246-248, 1998.
539. Evora, C., Soriano, I., Rogers, R., Hanes, J., Shakesheff, K., Langer, R. Relating the phagocytosis of microparticles by alveolar macrophages to surface chemistry: The effect of 1,2-dipalmitoylphosphatidylcholine, Journal of Controlled Release, 51: 143-152, 1998
540. Langer, R., Drug delivery and targeting, Nature, 392 (Supp): 5-10, 1998.
541. Shinoka, T., Shum-Tim, D., Ma, P., Tanel, R., Isogai, N., Langer, R., Vacanti, J., Mayer, J.E. Creation of viable pulmonary artery autografts through tissue engineering, J. Thor. and Cardiovasc. Surg. 115:3, 536-546, 1998.
542. Vunjak-Novakovic G., Obradovic B., Bursac P., Martin, I., Langer R. Freed L. Dynamic cell seeding of polymer scaffolds for cartilage tissue engineering. Biotechnol. Prog. 14: 193-202, 1998.
543. Freed, L., Hollander, A., Martin, I., Barry, J., Langer, R., Vunjak-Novakovic, G. Chondrogenesis in a cell-polymer-bioreactor system, Exper. Cell Res., 240: 58-65, 1998.
544. Pollock, J., Kluth, D., Cusick, R., Lee, H., Utsunomiya, H., Ma, P., Langer, R., Broelsch, C., Vacanti, J., Formation of spheroidal aggregates of hepatocytes on biodegradable polymers under continuous-flow bioreactor conditions. European Journal of Pediatr. Surg. Vol. 8: 195-199, 1998.
545. Hanes, J., Chiba, M., Langer, R. Degradation of porous poly(anydride-*co*-imide) microspheres and implications for controlled macromolecule delivery, Biomaterials, 19: 163-172, 1998.
546. Cannizzaro, S., Padera, R., Langer, R., Rogers, R., Black, F., Davies, M., Tendler, S., Shakesheff, K., A novel biotinylated degradable polymer for cell-interactive applications. Biotechnology and Bioengineering, 58: 529-535 1998.
547. Kohane, D., Yieh, J., Lu, N., Langer, R., Strichartz, G., Berde, C. A re-examination of tetrodotoxin for prolonged duration local anesthesia. Anesthesiology, 89: 119-131 1998.
548. Schwendeman, S., Tobio, M., Joworowicz, M., Alonso, J., Langer, R. New strategies for the microencapsulation of tetanus vaccine. J. Microencapsulation, 15: 299-318 1998.
549. Costantino, J., Schwendeman, S., Langer, R., Klibanov, A. Deterioration of lyophilized pharmaceutical proteins. Biochem. (Moscow), 63: 357-363 1998.
550. Ibim, S., Uhrich, K., Bronson, R., El-Amin, S.F., Langer, R., Laurencin, C. Poly(anhydride-co-imides): in vivo biocompatibility in a rat model. Biomaterials, 19: 944-951 1998.
551. Hadlock, T., Elisseeff, J., Langer, R., Vacanti, J., Cheney, M. A tissue-engineered conduit for facial nerve repair. Archives Otolaryngol Head & Neck Surg, 124(10): 1081-1086, 1998.
552. Shakesheff, K., Cannizzaro, S., Langer, R. Creating biomimetic micro-environments with synthetic polymer-peptide hybrid molecules. Journal of Biomaterials Science-Polymer Edition, 9: 507-518 1998.
553. Shastri, V., Marini, R., Padera, R., Kirchain, S., Tarcha, P., Langer, R. Osteocompatibility of photopolymerizable anhydride networks. Mats. Res. Soc. Symp. Proc., 530: 93-98, 1998.
554. Marler, J., Upton, J., Langer, R., Vacanti, J. Transplantation of cells in matrices for tissue regeneration. Adv. Drug Del. Rev., 33: 165-182, 1998.
555. Riesle, J., Hollander, A., Langer, R., Freed, L., Vunjak-Novakovic, G., Collagen in tissue-engineered cartilage: types, structure, and crosslinks. J. Cell. Biochem., 71: 313-327, 1998.
556. Chen, H., Langer, R. Oral particulate delivery: status and future trends. Adv. Drug Del., 34, 339-350, 1998.
557. Gao, J., Niklason, L., Langer, R. Surface hydrolysis of poly(glycolic acid) meshes increases the seeding density of vascular smooth muscle cells. Journal of Biomedical Materials Research, 42: 417-424, 1998.

558. Ma, P., Langer, R. Fabrication of bioegradable polymer foams for cell transplantation and tissue engineering. Methods in Molecular Medicine, 18: 47-56, J. Morgan and M.L. Yarmush (eds), Humana Press, Totowa, NJ, 1998.
559. Ibim S., Uhrich K., Attawia M, Shastri V., El-Amin S., Bronson R., Langer R., Laurencin CT, Preliminary in vivo report on the osteocompatibility of poly(anaydride-co-imides) evaluated in a tibial model. Journal of Biomedical Materials Research, 43: 374-379, 1998.
560. Tobio, M., Gref, R., Sanchez, A., Langer, R., Alonso, M., Stealth PLA-PEG nanoparticles as protein carriers for nasal administration. Pharmaceutical Research, 15: 2, 270-275, 1998.
561. Chen, T., Langer, R., Weaver, J. Skin electroporation causes molecular transport across the stratum corneum through localized transport regions. Journal of Investigative Dermatology, 3: 159-165, 1998.
562. Patel, N., Padera, R., Sanders, G., Cannizzaro, S., Davies, M., Langer, R., Roberts, C., Tendler, S., Williams, P., Shakesheff, K. Spatially controlled cell engineering on biodegradable polymer surfaces. FASEB Journal, 12: 1447-1457, 1998.
563. Chen, T., Segall, E., Langer, R., Weaver, J. Skin electroporation: rapid measurements of the transdermal voltage and the flux of four fluorescent molecules show a transition to large fluxes near 50v. Journal of Pharmaceutical Science, 87: 1368-1374, 1998.
564. Uhrich, K., Ibim, S., Larrier, D., Langer, R., Laurencin, C., Chemical changes during *in vivo* degradation of poly(anhydride-imide) matrices, Biomaterials 19, 2045-2050, 1998.
565. Riesle, J., Hollander, A., Langer, R., Freed, L., Vunjak-Novakovic, G., Collagen in tissue-engineered cartilage: types, structure and crosslinks. Journal of Cellular Biochemistry, 71, 313-327, 1998
566. Gooch, K.J., Blunk, T., Vunjak-Novakovic, G., Langer, R., Freed, L., Mechanical forces and growth factors utilitzed in tissue engineering, "Frontiers in Tissue Engineering," Ch. II.3, Pergamon Press, Oxford, U.K. ; New York, NY, U.S.A., 1998.
567. Moses, M., Weiderschain, D., Wu, I., Fernandez, C., Ghazizadeh, V., Lane, W., Flynn, E., Sytkowski, A., Tao, T., Langer, R. Troponin I is present in human cartilage and inhibits angiogenesis. PNAS, 96: 2645-2650, 1999.
568. Stading, M., Langer, R. Mechanical shear properties of cell-polymer cartilage constructs. Tissue Engineering, 5: 3, 241-250, 1999.
569. Chen, T., Langer, R., Weaver, J. Charged microbeads are not transported across the human stratum corneum in vitro by short high-voltage pulses. Bioelectrochemistry and Bioenergetics, 48: 181-192, 1999.
570. Ben-Jebria, A., Chen, D., Eskew, M., Vanbever, R., Langer, R., Edwards, D. Large porous particles for sustained protection from carbachol-induced bronchoconstriction in guinea pigs. Pharmaceutical Research 16: 555-561, 1999.
571. Ma, P., Langer, R. Morphology and mechanical function of long-term *in vitro* engineered cartilage. Journal of Biomedical Matericals Research, 44: 217-221, 1999.
572. Caponetti, G., Hrkach, J., Kriwet, B., Poh, M., Lotan, N., Colombo, P., Langer, R. Microparticles of novel poly(lactic acid-co-amino acid) graft copolymers: Preparation and characterization, Journal of Pharmaceutical Science, 88: 136-141, 1999.
573. Ando, S., Putnam, D., Pack, D., Langer, R. PLGA microspheres containing plasmid DNA: Preservation of supercoiled-DNA via cryopreparation and carbohydrate stabilization. Journal of Pharmaceutical Science, 88: 126-130, 1999.
574. Santini, J., Cima, M., Langer, R. A Controlled-release Microchip. Nature, 397: 335-338, 1999.
575. Ameer, G., Grovender, E., Obradovic, B., Cooney, C., Langer, R. RTD Analysis of a novel taylor-couette flow device for blood detoxification. AIChE Journal, 45: 3, 633-638, 1999.
576. Zewert, T., Pliquett, U., Vanbever, R., Langer, R., Weaver, J. Creation of transdermal pathways fro macromolecule transport by skin electroporation and a low toxicity, pathway-enlarging molecule. Bioelectrochem. Bioenerget. 49: 11-20, 1999.
577. Ameer, G.A., Harmon, W., Sasisekharan, R., Langer, R. Investigation of a whole blood fluidized bed taylor-couette flow device for enzymatic heparin neutralization. Biotechnology and Bioengineering, 62: 602-608, 1999.
578. Kohane, D., Kuang, Y., Nu, T., Langer, R., Strichartz, G., Berde, C. Vanilloid receptor agonists potentiate the in vivo local anesthetic activity of percutaneously injected site 1 soldium channel blockers. Anesthesiology, 90: 2, 524-534, 1999.
579. Pack, D., Putnam, D., Langer, R. Design of imidazole-containing endosomolytic biopolymers for gene delivery. Biotechnology and Bioengineering, 67: 217-223, 1999.

580. Elisseff, K., Anseth, D., Sims, W., McIntosh, W., Randolph, M., Langer, R. Transdermal photopolymerization for minimally invasive implantation. PNAS, 96: 3104-3107, 1999.
581. Niklason, L., Gao, J., Abbot, W., Hirschi, K., Houser, S., Marini, R., Langer, R. Functional arteries grown *in vitro*, Science, 284: 489-493, 1999.
582. Anseth, K., Shastri, V., Langer, R. Photopolymerizable degradable polyanhydrides with osteocompatibility. Nature Biotechnology, 17: 156-159, 1999.
583. Vunjak-Novakovic, G., Martin, I., Obradovic, B., Treppo, S., Grodzinsky, A., Langer, R., Freed, L. Bioreactor cultivation conditions modulate the composition and mechanical properties of tissue engineered cartilage. Journal of Orthopaedic Research, 17: 1, 130-138, 1999.
584. Sinisterra, R., Shastri, V., Najjar, R., Langer, R. Encapsulation and release of rhodium (II) citrate and its association complex with hydroxypropyl-B-cyclodextrin from biodegradable polymer Microspheres. Journal of Pharmaceutical Science, 88:5, 574-576, 1999.
585. Ameer, G., Barabino, G., Sasisekharan, R., Harmon, W., Cooney, C., Langer, R. *Ex vivo* evaluation of a novel taylor-couette flow, immobilized heparinase I device for clinical application. Proc. Nat. Acad. Sci., 96: 2350-2355, 1999.
586. Fu, K., Griebenow, K., Hsieh, L., Klibanov, A., Langer, R. FTIR characterization of the secondary structure of proteins encapsulated within PLGA mircrospheres. Journal of Controlled Release, 58: 3, 357-366, 1999.
587. Zelikin, A., Shastri, V., Langer, R. Facile synthesis of 3-alkylpyrroles. Journal of Organic Chemistry, 64: 9, 3379-3380, 1999.
588. Langer, R., Vacanti, J. Tissue engineering: the challenges ahead. Scientific American, 280: 62-65, 1999.
589. Putnam, D., Langer, R. Poly(4-hydroxy-L-proline ester): low-temperature polycondensation and plasmid DNA complexation. Macromolecules, 32: 11, 3658-3662, 1999.
590. Shakesheff, K., Davies, M., Langer, R. Surface characterization methods. J. Biomat. Sci., 9: 507-518, 1999.
591. Attawia, M., Herbert, K., Uhrich, K., Langer, R., Laurencin, C. Proliferation, morphology, and protein expression by osteoblasts cultured on poly(anhydride-co-imides). Journal of Biomedical Materials Research, 48: 322-327, 1999.
592. Kost, J., Mitragotri, S., Langer, R. Phonophoresis, in Percutaneous Absorption: Drugs-Cosmetics-Mechanisms-Method, edited by Robert L. Bronaugh, Howard I. Maibach, Vol. 97, 3rd Edition, p. 615-631, 1999.
593. Dillow, A., Dehghani, F., Hrkach, J., Foster, N., Langer, R. Bacterial inactivation by using near- and supercritical carbon dioxide. Proceedings of the National Academy of Sciences, 96: 10344-10348, 1999.
594. Elisseeff, J., Winnette, M., Anseth, K., Langer R. Cogelation of hydrolyzable cross-linkers and poly(ethylene oxide) dimethacrylate and their use as controlled release vehicles, in Intelligent Mat. for Cont, Rel: ACS Symp. Ser. 728: 1-13, Dinh, S., DeNuzzio, J., Comfort, A., eds. 1999.
595. Vanbever, R., Ben-Jebria, A., Mintzes, J., Langer, R., Edwards, D. Sustained release of insulin from insoluble inhaled particles. Drug Delivery Research, 48: 178-185, 1999.
596. Vacanti, J. and Langer, R., Tissue engineering: The design and fabrication of living replacement devices for surgical reconstruction and transplantation, Lancet 354: 32-34, 1999.
597. Carrier, R., Papadaki, M., Rupnick, M., Schoem, F.J., Bursac, N., Langer, R., Freed, L., Vunjak-Novakovic, G. Cardiac tissue engineering: cell seeding, cultivation parameters, and tissue construct characterization. Biotechnology & Bioengineering 64: 580-589, 1999.
598. Vanbever, R., Mintzes, J., Wang, J., Nice, J., Chen, D., Batycky, R., Langer, R., Edwards, D. Formulation and physical characterization of large porous particles for inhalation. Pharmaceutical Research, 16: 1735-1742, 1999.
599. Weaver, J., Langer, R. Electrochemical creation of large aqueous pathways: an approach to transdermal drug delivery. Progress in Dermatology, 33: 1-10, 1999.
600. Mitragotri, S., Johnson, M., Blankschtein, D., Langer, R. An analysis of the size selectivity of solute partitioning, diffusion, and permeation across lipid bilayers. Biophysical Journal, 77: 1268-1283, 1999.
601. Langer, R. Selected advances in drug delivery and tissue engineering. Journal of Controlled Release, 62: 7-11, 1999.
602. Uhrich, K., Cannizzaro, S., Langer, R., Shakesheff, K. Polymeric systems for controlled drug release. Chemical Reviews, 99: 3181-3198, 1999.
603. Ameer, G., Raghavan, S., Sassisekharan, R., Cooney, C., Harmon, W., Langer, R. Regional heparinization via Simultaneous separation and reaction in a novel taylor-couette flow device. Biotechnology and Bioengineering, 63: 618-624, 1999.

604. Papadaki, M., Langer, R. Cardiomyoplasty: Cellular tissue engineering approaches. Basic and Appl. Myology, 9: 151-159, 1999.
605. Stading, M., Langer, R. Rheological properties and microstructure of tissue engineered cartilage. The Wiley Poly. Network. Group Rev. Series, 32: 405-414, 1999.
606. Elisseeff, J., Anseth, K., Sims, D., McIntosh, W., Randolph, M., Yaremchuk, M., Langer, R. Transdermal Photopolymerization of PEO-based injectable hydrogels for tissue engineered cartilage. Plastic and Reconstructive Surgery, 104: 1014-1022, 1999.
607. Bryant, S., Martens, P., Elisseeff, J., Randolph, M., Langer, R., and Anseth, K. Transtissue photopolymerization of Poly(Vinyl Alcohol) hydrogels. *Chemical and physical networks: Formation and control of properties*, The Wiley Polymer Networks Group Review Series, vol 2, B.T. Stokke and A. Elgsaeter (ed.), p. 395, Wiley, New York, 1999.
608. Weaver, J., Pliquett, U., Zewart, T., Vanbever, R., Herndon, T., Gowrishankar, T., Chen, T., Prausnitz, M., Vaughan, T., Chizmadzhev, Y., Preat, V., Langer, R. Recent advances in skin electroporation: mechanism and efficacy. In Elec. And Magnetism in Bio. And Med., F. Bersani, ed. New York: Plenum Press, 149-152, 1999.
609. Patel, N., Sanders, G.H.W., Shakesheff, K.M, Cannizzaro, S.M., Davies, M.C., Langer, R., Roberts, C.J., Tendler, S.J.B., Williams, P.M. Atomic force microscopy analysis of highly defined proteins formed by microfluidic networks. Langmuir, 15: 7252-7257, 1999.
610. Shakesheff, K.M, Davies, M.C., Langer,R. The use of XPS in surfactant surface analysis. Surfactant Science Series, 87: 143-172, 1999.
611. Black, R., Hartshorne, M., Davies, M., Roberts, C., Tendler, S., Williams, P., Shakesheff, K., Cannizzaro, S., Kim, I., Langer, R. Surface engineering and surface analysis of a biodegradable polymer with biotinylated end-groups. Langmuir, 15: 3157-3161, 1999.
612. Shum-Tim, D., Stock, U., Hrkach, J., Shinoka, T., Lien, J., Moses, M., Stamp, A., Taylor, G., Moran, A., Landis, W., Langer, R., Vacanti, J., Mayer, J.E. Tissue engineering of autologous aorta using a new biodegradable polymer. Annals of Thoracic Surgery, 68: 2298-2304, 1999.
613. Crumpler, E., Imoukhuede, P., Kitchens, K., Keawphalouk, M., Landa, J. and Langer, R, Controlled release of 9-chloro-2-methylellipticium acetate from a biodegradable polymer: Release kinetics, *in vitro* and *in vivo* effects on cellular growth, Polymer Preprints, 40: 605-606, 1999.
614. Fu, K., Klibanov, A., Langer, R. Protein stability in controlled release systems, Nature Biotech., 18: 24-25, 2000.
615. Kost, J., Mitragotri, S., Gabbay, R., Pishko, M., Langer, R. Transdermal monitoring of glucose and other analytes using ultrasound. Nature Medicine, 6: 347-350, 2000.
616. Kim, B., Langer, R., Hrkach, J. Biodegradable photo-crosslinked poly (ether-ester) networks for lubricious coatings. Biomaterials, 21: 259-265, 2000.
617. Langer, R. Tissue engineering. Mol. Therapy, 1:12-15, 2000.
618. Mitragotri, S., Farrell, J., Tang, H., Terahara, T., Kost, J., Langer, R. Determination of the threshold energy for ultrasound-induced transdermal drug delivery. Journal of Controlled Release, 63: 41-52, 2000.
619. Tobio, M., Schwendeman, S., Guo, Y., McIver, J., Langer, R., Alonoso, M. Improved immunogenicity of a core-coated tetanus toxoid delivery system, Vaccine, 18: 618-622, 2000.
620. Fu, K., Pack, D., Klibanov, A., Langer, R. Visual evidence of acidic environment within degrading PLGA microspheres. Pharmaceutical Research 17: 100-106, 2000.
621. Langer, R., Biomaterials, Status, Challenges, and Perspectives. AIChE Journal, 46: 1286-1289, 2000.
622. Shastri, V., Martin, I., Langer, R. Macroporous polymer foams by hydrocarbon templating, Proc. Nat. Acad. Sci., 97: 1970-1975, 2000.
623. Elisseeff, J., McIntosh, W., Ragan, P., Anseth, K., Riley, S., Langer, R. Photoencapsulation of chondrocytes in poly(ethylene oxide)-based semi interpenetrating networks. Journal of Biomedical Materials Research, 2: 164-171, 2000.
624. Santini, J., Richards, A., Scheidt, R., Cima, M., Langer, R. Microchips as controlled release devices. Angewandte Chemie, 39: 2396-2407, 2000.
625. Santini, J., Richards, A., Scheidt, R., Cima, M., Langer, R. Microchip technology in drug delivery. Annals of Medicine, 32: 377-379, 2000.
626. Mitragotri, S., Coleman, M., Kost, J., Langer, R. An analysis of ultrasonically extracted interstitial fluid as a predictor of blood glucose levels. J. Appl. Physiol., 89: 961-966, 2000.

627. Lu, L., Peter, S., Lyman, M., Lai, H., Leite, S., Tamada, J., Vacanti, J., Langer, R., Mikos, A. In vitro degradation of porous poly(L-lactic acid) foams. Biomaterials, 21: 1595-1605, 2000.
628. Lu, L., Peter, S., Lyman, M., Lai, H., Leite, S., Tamada, J., Uyama, S., Vacanti, J., Langer, R., Mikos, A. In vitro and in vivo degradation of porous poly(DL-lactic-co-glycolic acid) foams. Biomaterials, 21: 1837-1845, 2000.
629. Langer, R. Biomaterials in drug delivery and tissue engineering: one laboratory's experience. Accounts of Chemical Research, 33: 94-101, 2000.
630. Langer, R., New tissues for old. Chemistry in Britain, 36: 32-34, 2000.
631. Mitragotri, S., Kost, J., Langer, R. Enhancement of transdermal transport through a synergistic effect of ultrasound and other enhancers, in Handbook of Pharm. Cont. Rel. Tech., Wise, D. ed., Marcel Dekker, 607-616, 2000.
632. Mitragotri, S., Langer, R., Kost, J. Ultrasound for modulation of skin transport properties, in Biomaterials Engineering and Devices: Human Applications. Wise, D., ed., Trantolo, D., Altobeli, D., Yazemski, M., Wnek, G., and Gresser, J. Marcel Dekker, 843-854, 2000.
633. Mitragotri, S., Ray, D., Farrell, J., Tang, H., Yu, B., Kost, J., Blankschtein, D., Langer, R. Synergistic effect of low-frequency ultrasound and Sodium Lauryl Sulfate on transdermal transport. Journal of Pharmaceutical Sciences, 89, 892-900, 2000.
634. Mitragotri, S., Kost, J., Langer, R. Non-invasive drug delivery and diagnostics using low-frequency sonophoresis. Recent Advances and Research Updates in Medicine, 1, 43-48, 2000.
635. Mitragotri, S., Coleman, M., Kost, J., Langer, R. Transdermal extraction of analytes using low-frequency ultrasound. Pharmaceutical Research 17, 466-470, 2000.
636. Schaefer, D., Martin, I., Shastri, P., Padera, R., Langer, R., Freed, L., Vunjak-Novakovic. In vitro generation of osteochondral composites. Biomaterials, 21: 2599-2606, 2000.
637. Lynn, D., Langer, R. Degradable poly(β-amino esters): synthesis, characterization, and self-assembly with plasmid DNA, J. Am. Chem. Soc., 122: 10761-10768, 2000.
638. Chen, T., Langer, R., Weaver, J., Transdermal drug delivery by skin electroporation, in Handbook of Pharm. Cont. Rel. Tech., Wise, D. ed., Marcel Dekker, 2000, 597-605.
639. Langer, R. Tissue engineering: Status and challenges. The Journal of Regen. Med., 1: 5-6, 2000.
640. Kost, J., Mitragotri, S., Gabbay, R., Pishko, M., Langer, R. Non-Invasive Blood Glucose Measurement Using Ultrasound. Nature Medicine, 6: 347-350, 2000.
641. Mitragotri, S., Coleman, M., Kost, J., Langer, R. Non-invasive blood analyte extraction using ultrasound. Pharmaceutical Research, 17: 467-470, 2000.
642. Kohane, D., Lipp, M., Kinney, R., Lotan, N., Langer, R. Sciatic nerve blockade with lipid-protein-sugar particles containing bupivacaine. Pharmaceutical Research, 17: 1243-1249, 2000.
643. Patel, N., Bhandari, R., Shakesheff, K.M., Cannizzaro, S., Davies, M., Langer, R., Roberts, C., Tendler, S., Williams, P., Printing Patterns for Biospecifically Adsorbed Proteins, Journal of Biomaterials Science Polymer Edition, 11: 319-331, 2000.
644. Crumpler, E., Venkataraman, G. and Langer, R., Cellular delivery of PNA via de novo designed template assembled porating peptides (Molecular TAPP): Targeting Telomerase?, *Miami Nature Biotechnology Short Reports*, Volume 11 Advances in Gene Technology: DNA, RNA and Cancer, 79, 2000.
645. Papadaki, M., Mahmood, T., Gupta, P., Classe, M., Grijpma, D., Riesle, J., van Blitterswijk, C., Langer, R. The different behaviors of skeletal muscle cells and chondrocytes on PEGT/PBT block copolymers are related to the surface properties of the substrate, Journal of Biomedical Materials Research, 54: 47-58, 2001.
646. Gooch, K.J., Kwon, J.H., Blunk, T., Langer, R., Freed, L.E., Vunjak-Novakovic, G., Effects of mixing intensity on tissue-engineered cartilage. Biotechnology and Bioengineering 72, 4: 402-407, 2001.
647. Putnam, D., Gentry, C., Pack, D., Langer, R., Polymer-based gene delivery with low cytotoxicity by a unique balance of side chain termini. Proc. Nat. Acad. Sci., 98: 3, 1200-1205, 2001.
648. Hirosue, S., Muller, B., Mulligan R., Langer, R. Plasmid DNA encapsulation and release from solvent diffusion nanospheres. Journal of Controlled Release, 70: 231-242, 2001.
649. Lendlein, A, Schmidt, A.M., Langer, R. AB-Polymer networks based on oligio(ε-caprolactone) segments showing shape memory properties, Proc. Nat. Acad. Sci, 98: 3, 842-847, 2001.
650. Niklason, L., Langer, R. Prospects for Organ and Tissue Replacements. J. Am. Med. Assoc. 285: 573-576, 2001.
651. Tang, H., Mitragotri, S., Blankschtein, D., Langer, R. Theoretical description of transdermal transport of hydrophilic permeants: application to low-frequency sonophoresis, Journal of Pharmaceutical Sciences, 90: 545-568, 2001.

652. Martin, I., Shastri, V., Padera, R., Yang, J., Mackay, A., Langer, R., Vunjak-Novakovic, G., Freed, L. Selective differentiation of mammalian bone marrow stromal cells cultured on three-dimensional polymer foams. Journal of Biomedical Materials Research. 55: 229-235, 2001.
653. Niklason, L., Abbott, W., Gao, J., Klagges, B., Hirschi, K., Ulubayram, K., Conroy, N., Jones, R., Vasanwala, A., Sanzgiri, S., Langer, R. Morphologic and mechanical characteristics of engineered bovine arteries. J. Vasc. Surg. 33: 628-638, 2001.
654. Papadaki, M., Bursac, N. Langer, R., Merok, J., Vunjak-Novakovic, G., Freed. L.E., Tissue engineering of functional cardiac muscle: Molecular, structural and electrphysiological evaluations, Amer. J. of Heart Circ. Physiol., 280: H168-H178, 2001.
655. Lesniak, M., Langer, R., Brem, H. Drug delivery to tumors of the central nervous system. Current Neurology & Neuroscience Reports, 1, 210-216, 2001.
656. Choi, W.S., Krishnamurthy, G.G., Edwards, D.A. Langer, R., Klibanov, A.M., Inhalation delivery of proteins from ethanol suspensions, Proc. Nat. Acad. Sci., 98: 11103-11107, 2001.
657. Yu, B., Dong, C., So, P.T.C., Blankschtein, D., Langer, R. *In vitro* visualization and quantification of oleic acid induced changes in transdermal transport using two-photon fluorescence microscopy. Journal of Investigative Dermatology, 117, 16-25, 2001.
658. Ameer, G., Grovender, E., Ploegh, H., Ting, D., Owen, W., Rupnick, M., Langer, R. A novel immunoadsorption device for removing β2 microglobulin from whole blood. Kidney International, 59, 1544-1550, 2001.
659. Mathiowitz, E., Jacob, J., Jong, Y., Hekal, T., Spano, W., Guemonprez, R., Klibanov, A., Langer, R. Novel desiccants based on designed polymeric blends, Journal of Applied Polymer Science, 80, 317-327, 2001.
660. Lavik, E., Hrkach, J., Lotan, N., Nazarov, R., Langer, R. A simple synthetic route to the formation of a block copolymer of poly(lactic-*co*-glycolic acid) and polylysine for the fabrication of functionalized, degradable structures for biomedical applications. Journal of Biomedical Materials Research, 58: 291-294, 2001.
661. Lahann, J., Hocker, H., Langer, R. Synthesis of Amino [2.2]paracyclophanes, Beneficial Monomers for Bioactive Coating of Medical Implant Materials. Angewandte Chemie International Edition, 40, 726-728, 2001.
662. Choi, I., Langer, R. Surface-Initiated Polymerization of L-Lactide: Coating of Solid Substrates with a Biodegradable Polymer. Macromolecules, 34: 5361-5363, 2001.
663. Grovender, E., Cooney, C., Langer, R., Ameer, G. Modeling the Mixing Behavior of a Novel Fluidized Extracorporeal Immunoadsorber. Chemical Engineering Science, 56, 5437-5441, 2001.
664. Perez, C., Sanchez, A., Putnam, D., Ting, D., Langer, R., Alonso, M.J. Poly(lactic acid)-poly(ethylene glycol) nanoparticles as new carriers for the delivery of plasmid DNA. Journal of Controlled Release, 75: 211-224, 2001.
665. Lahann, J., Choi, I., Lee, J., Jensen, K., Langer, R. A new method toward microengineered surfaces based on reactive coating. Angewandte Chemie, 40: 3166-3169, 2001.
666. Lynn, D., Amiji, M., Langer, R. pH-responsive polymer microsphere: Rapid release of encapsulated material within the range of intracellular pH. Angewandte Chemie, 40: 1707-1710, 2001.
667. Lynn, D., Anderson, D., Putnam, D., Langer, R., Accelerated discovery of synthetic transfection vectors: Parallel synthesis and screening of a degradable polymer library, Journal of the American Chemical Society, 123: 8155-8156, 2001.
668. Langer, R., Perspectives: Drug delivery – drugs on target, Science, 293:58-59, 2001.
669. Ameer, G., Mahmood, T., Langer, R., A biodegradable composite scaffold for cell transplantation. Journal of Orthopaedic Research, 20: 16-19, 2001.
670. Lahann, J. and Langer, R., Surface-initiated ring opening polymerization of ε-Caprolactone from a patterned poly[(hydroxymethyl)-p-xylylene]. Macromolec. Rapid Comm., 22: 968-971, 2001.
671. Ameer, G., Crumpler, E., Langer, R., Cell killing potential of a water-soluble radical initiator, Intl. J. of Cancer, 93: 875-879, 2001.
672. Elisseeff, J., McIntosh, W., Fu, K., Blunk, T., Langer, R. Controlled-release of IGF-I and TGF-β1 in a photopolymerizing hydrogel for cartilage tissue engineering. Journal of Orthopaedic Research, 19: 1098-1104, 2001.
673. Tarcha, P., Su, L., Baker, T., Langridge, D., Shastri, V., Langer, R., Stability of Photo-Curable Anhydrides: Methacrylic Acid Mixed Anhydrides of Non-Toxic Diacids. Journal of Polymer Science. 39: 4189-4195, 2001.
674. Kohane, D., Lipp, M., Kinney, R., Anthony, D., Louis, D., Lotan, N., Langer, R. Biocompatibility of lipid-protein sugar particles containing bupivacaine in the epineurium, J. Biomat. Research, 59: 450-459, 2002.

675. LaVan, D., Lynn, D., Langer, R., Moving smaller in drug delivery and discovery, Nature Reviews Drug Discovery, 1: 77-84, 2002.
676. Carrier, R., Rupnick, M., Langer, R., Schoen, F., Freed, L., Vunjak-Novakovic, G., Perfusion improves tissue architecture of engineered cardiac muscle, Tissue Engineering, 8: 175-188, 2002.
677. Zelikin, A., Shastri, V., Lynn, D., Farhadi, J., Martin, I., Langer, R., Erodible conducting polymers for potential biomedical applications, Angewandte Chemie, Int. Ed., 41: 141-144, 2002.
678. Lee H, Cusick RA, Browne F, Kim TH, Peter X, Utsunomiya MH, Langer R, Vacanti JP. Local delivery of basic fibroblast growth factor increases both angiogenesis an engraftment of hepatocytes in tissue-engineered polymer devices. Transplantation 73:1589-1593, 2002
679. Teng, Y.D., Lavik, E.B., Qu, X., Park, K., Ourednik, J., Zurakowsi, D., Langer, R., Snyder, E.Y., Functional recovery following traumatic spinal cord injury mediated by a unique polymer scaffold seeded with neural stem cells. Proc. Nat. Acad. of Sci., 99: 3024-3029, 2002.
680. Terahara, T., Mitragotri, S., Langer, R., Porous resins as a cavitation enhancer for low-frequency sonophoresis, J. Pharm. Sci. 91: 753-759, 2002.
681. Terahara, T., Mitragotri, S., Kost, J., Langer, R. Dependence of Low-frequency Sonophoresis on Ultrasound Parameters; Distance of the Horn, Intensity, and Frequency. Int. Journal Pharm., 235: 35-42, 2002.
682. Carrier, R., Rupnick, M., Langer, R., Schoen, F., Freed, L., Vunjak-Novakovic, G., Effects of oxygen on engineered cardiac muscle, Biotech. & Bioeng., 78: 617-625, 2002.
683. Cannizzaro, S. and Langer, R., Biomaterials: Synthetic and engineering strategies, in Biomimetic materials and design: Biointerfacial Strategies, tissue engineering and targeted drug delivery, 2002, 251-281. Eds: A.K. Dillow and A.M. Lowman, Marcel Dekker, Inc., NY
684. Blunk, T., Sieminski, A., Gooch, K., Courter, D., Hollander, A., Nahir, A.M., Langer, R., Vunjak-Novakovic, G., Freed, L., Differential effects of growth factors on tissue-engineered cartilage, Tissue Engineering, 8: 73-84, 2002.
685. Levenberg, S., Golub, J., Amit, M., Eldor, J. and Langer, R., Endothelial cells derived from human embryonic stem cells, PNAS, 99: 4391-4396, 2002.
686. Akinc, A., Langer, R., Measuring the pH environment of DNA delivered using nonviral vectors: Implications for lysosomal trafficking. Biotechnology and Bioengineering, 78: 503-508, 2002.
687. Lendlein, A. and Langer, R., Biodegradable, elastic thermoplastic shape memory polymers with adjustable properties for potential biomedical applications, Science, 296: 1673 - 1676, 2002.
688. Lahann, J. and Langer, R., Novel poly(p-xylylenes): Thin films with tailored chemical and optical properties, Macromolecules, 35: 4380-4386, 2002.
689. Wang, Y., Ameer, G.A., Sheppard, B.J. and Langer, R., A tough biodegradable elastomer, Nature Biotech, 20: 602-606, 2002.
690. Grovender, E., Ameer, G., Cooney, C., Langer, R., Immunoadsorption model for a novel fluidized-bed blood detoxification device, AIChE Journal, 48: 2357-2365, 2002.
691. Kohane, D., Plesnila, N., Thomas, S., Le, D., Langer, R., Moskowitz, M., Lipid-sugar particles for intracranial drug delivery: Safety and biocompatibility, Brain Research, 946: 206-213, 2002.
692. Katti, D.S., Lakshmi, S., Langer, R., Laurencin, C.T., Toxicity, biodegradation and elimination of polyanhydrides, Advanced Drug Delivery, 54: 933-961, 2002.
693. Kumar, N., Langer, R.S., Domb, A.J., Polyanhydrides: An overview, Advanced Drug Delivery Reviews, 54: 889-910, 2002.
694. Madry, H., Padera, R., Seidel, J., Langer, Robert, Freed, L.E., Trippel, S.B., Vunjak-Novakovic, G., Gene transfer of human insulin-like growth factor IcDNA enhances tissue engineering of cartilage. Human Gene Therapy, 13: 1621-1630, 2002.
695. Yu, B., Kim, K.H., So, P.T.C., Blankschtein, D., Langer, R., Topographic heterogeneity in transdermal transport revealed by high speed two-photon microscopy: determination of representative skin sample sizes, J. of Invest. Derm.,118: 1085-1088, 2002.
696. Zelikin, A., Putnam, D., Shastri, P., Langer, R., Izumrudov, V., Aliphatic ionenes as gene delivery agents: elucidation of structure – function relationship through modification of charge density and polymer length, Bioconj. Chem., 13: 548-553, 2002.
697. Potineni, A., Lynn, D., Langer, R., Amiji, M., Poly(ethylene oxide)-modified poly(β-amino ester) nanoparticles as a pH-sensitive biodegradable system for paclitaxel delivery, J. of Controlled Release, 86: 223-234, 2002.

698. Lahann, J. Rodon, T., Balcells, M., Jensen, K., Lee, C.J.Y. and Langer, R. Reactive polymer coatings: A platform for patterning proteins and mammalian cells onto a broad range of materials, Langmuir, 18: 3632-3638, 2002.
699. Kohane, D.S., Holmes, G.L., Chau, Y., Zurakowski, D., Langer, R., Cha, B.H., Effectiveness of muscimol-containing microparticles against pilocarpine-induced focal seizures, Epilepsia, 43: 1462-1468, 2002.
700. Tang, H., Wang, C., Blankschtein, D., Langer, R., An Investigation of the role of cavitation in low-frequency ultrasound-mediated transdermal drug transport. Pharmaceutical Research, 19: 1160-1169, 2002.
701. Tang, H., Blankschtein, D., Langer, R., Effects of low-frequency ultrasound on the transdermal permeation of mannitol: Comparative studies with *in vivo* and *in vitro* skin, Journal of Pharmaceutical Sciences, 91: 1776-1794, 2002.
702. Tang, H., Blankschtein, D., Langer, R., Prediction of Steady-State Skin Permeabilities of Polar and Nonpolar Permeants across Excised Pig Skin Based on Measurements of Transient Diffusion: Characterization of Hydration Effects on the Skin Porous Pathway, Journal of Pharmaceutical Sciences, 91: 1891-1907, 2002.
703. Lavik, E., Teng, Y.D., Snyder, E. and Langer, R., Seeding neural stem cells on scaffolds of PGA, PLA and their copolymers, Methods Mol. Biol., 198: 89-97, 2002.
704. Lahann, J., Mitragotri, S., Tran, T., Kaido, H., Sundaran, J., Hoffer, S., Somorjai, G. A. and Langer, R., Reversible switching of surfaces, Science, 299: 371-374, 2003.
705. Lee, P., Langer, R., Shastri, V., Novel microemulsion enhancer formulation for simultaneous transdermal delivery of hydrophilic and hydrophobic drugs, Pharmaceutical Research, 20: 264-269, 2003.
706. Sundaram, M., Qi, Y., Shriver, Z., Liu, D., Zhao, G., Venkataraman, G., Langer, R., Sasiskharan, R., Rational design of low molecular weight heparins with improved *in vivo* activity, PNAS, 100: 651-656, 2003.
707. Langer, R. Where a pill won't go, Scientific American, 288: 50-57, 2003.
708. Voskerician, G., Shive, M., Shawgo, R., Von Recum, H., Anderson, J., Cima, M., Langer, R., Biocompatibility and biofouling of MEMS drug delivery device, Biomaterials, 24: 1959-1967, 2003.
709. LaVan, D., George, P.M, Langer, R., Simple three-dimensional microfabrication of electrodeposited structures, Angewandte Chemie, 42: 1262-1265, 2003.
710. Yu, B., Kim, K.H., So, P.T.C., Blankschtein, D., Langer, R, Visualization of oleic acid-induced transdermal diffusion pathways using two-photon fluorescence microscopy., Journal of Invest. Derm., 120: 448-455, 2003.
711. Fu, K., Harrell, R., Zinski, K., Um, C., Frazier, J., Lotan, N., Burke, P., Klibanov, A., Langer, R., A potential approach for decreasing the burst effect of protein from PLGA microspheres, Journal of Pharm. Sci., 92: 1582-1591, 2003.
712. Nashat, A. and Langer, R. Temporal characteristics of activation, deactivation and restimulation of signal transduction following depolarization in the pheochromocytoma cell line PC12, Molec. & Cell. Biol., 23: 4788-4795, 2003.
713. Baroli, B., Shastri, V.P., Langer, R., A method to protect sensitive molecules from a light-induced polymerizing environment, Journal of Pharm. Sci., 92: 1186-1195, 2003.
714. Kohane, D.S., Smith, S.E., Louis, D.N., Colombo, G., Ghoroghchian, P., Hunfeld, N.G.M., Berde, C.B. and Langer, R., Prolonged duration local anesthesia from tetrodotoxin-enhanced localanesthetic microspheres, Pain, 104: 415-421, 2003.
715. Akinc, A., Lynn, D., Anderson, D. and Langer, R., Parallel synthesis and biophysical characterization of a degradable polymer library for gene delivery, J. Am. Chem. Soc., 125: 5316-5323, 2003.
716. Anderson, D.G., Lynn, D.M., Langer, R., Semi-automated synthesis and screening of a large library of degradable cationic polymers for gene delivery, Angewandte Chemie, 42: 3153-3158, 2003.
717. Radisic, M., Euloth, M., Yang, L., Langer, R., Freed, L., Vunjak-Novakovic, G., High density seeding of myocyte cells for tissue engineering, Biotechnology & Bioengineering, 82: 403-414, 2003
718. Wang, Y., Kim, Y., Langer, R., *In vivo* degradation characteristics of poly(glycerol sebacate), Journal of Biomedical Materials Research, 66A: 192-197, 2003.
719. Shastri, V., Hildgen, P., Langer, R., *In situ* pore formation by differential polymer degradation, Biomaterials, 24: 3133-3137, 2003.
720. Valente, A., Langer, R., Stone, H., Edwards, D.A., Recent advances in the evelopment of an inhaled insulin product, BioDrugs, 17: 9-17, 2003.
721. Putnam, D., Zelikin, A., Izumrudov, V.A. and Langer, R. Polyhistidine-PEG: DNA nanocomposites for gene delivery, Biomaterials 24: 4425-4433, 2003.

722. Levenberg, S., Huang, N.F., Lavik, E., Rogers, A.B., Itskovitz-Eldor, J., Langer, R., Differentiation of human embryonic stem cells on three-dimensional polymer scaffolds, PNAS, 100: 12741-12746, 2003.
723. Grayson, A., Choi, I., Tyler, B., Wang, P., Brem, H., Cima, M.J. and Langer, R., Multi-pulse drug delivery from a resorbable polymeric microchip device, Nature Materials, 2: 767-772, 2003.
724. Kohane, D.S., Anderson, D.G., Yu, C. and Langer, R., pH-triggered release of macromolecules from spray-dried polymethacrylate microparticles, Pharm. Research, 20: 1533-1538, 2003.
725. Suh, K., Lahann, J. and Langer, R., Fabrication of elastomeric stamps with polymer-reinforced sidewalls via chemically selective vapor deposition polymerization of poly(*p*-xylylene), App. Phys. Ltrs., 83: 4250-4252, 2003.
726. Flynn, N.T., Tran, T., Cima, M. and Langer, R., Long term stability of self-assembled monolayers in biological media, Langmuir, 19: 10909-10915, 2003.
727. LaVan, D., McGuire, T. and Langer, R., Small-scale systems for in vivo drug delivery, Nature Biotech., 21: 1184-1191, 2003.
728. Yu, B., Blankschtein, D., Langer, R., Evaluation of fluorescent probe surface intensities as an indicator of transdermal permeant distributions using wide-area two-photon fluorescence microscopy, Journal of Pharm. Sci., 92: 2354-2365, 2003.
729. Shastri, V., Hildgen, P., Langer, R., *In situ* pore formation by differential polymer degradation, Biomaterials, 24: 3133-3137, 2003.
730. Moses, M., Brem, H., and Langer, R., Advancing the field of drug delivery: Taking aim at cancer, Cancer Cell, 4: 337-341, 2003.
731. Jon, S., Anderson, D.G. and Langer, R., Degradable poly(amino alcohol esters) as potential DNA vectors with low cytotoxicity, Biomacromolecules, 4: 1759-1762, 2003.
732. Jon, S., Seong, J., Khademhosseini, A., Tran, T., Laibinis, P. and Langer, R., Construction of nonbiofouling surfaces by polymeric self-assembled monolayers, Langmuir, 19: 9989-9993, 2003.
733. Lee, H., Cusick, R., Pollock, J., Utsunomiya, H., Ma, P., Langer, R., Vacanti, J., Effect of Implantation Site on Hepatocytes Heterotopically Transplanted on Biodegradable Polymer Scaffolds Tissue Engineering, 9: 1227-1232, 2003.
734. Akinc, A., Anderson, D.G., Lynn, D.M., Langer, R., Synthesis of poly(ß-amino esters) optimized for highly effective gene delivery, Bioconj. Chem., 14: 979-988, 2003.
735. Langer, R. and Peppas, N., Advances in Biomaterials, Drug Delivery, and Bionanotechnology, AIChE Journal, 49: 2990-3006, 2003.
736. Moses, M., Brem, H. and Langer, R., Novel delivery systems in cancer chemotherapy, Science and Medicine, 9: 264-273, 2003.
737. Locher, C., Putnam, D., Langer, R., Witt, S., Ashlock, B. and Levy, J., Enhancement of a human immunodeficiency virus env DNA vaccine using a novel polycationic nanoparticle formulation, Immunology Letters, 90: 67-70, 2003.
738. Teng, Y.D., Park, K., Ourednik, V., Ourednik, J., Lavik, E., Langer, R. and Snyder, E.Y., Use of biomaterials to help reveal aspects of neural stem cell (NSC) biology, 181: 107-108, 2003.
739. Langer, R., Transdermal drug delivery: Past progress, current status and future prospects, Adv. Drug Del. Rev., 56: 557-558, 2004.
740. Suh, K.Y., Seong, J., Khademhosseini, A., Laibins, P. and Langer, R., A simple soft lithographic route to fabrication of poly(ethyleneglycol) microstructures for protein and cell patterning, Biomaterials, 25: 557-563, 2004.
741. Prausnitz M., Mitragotri S., Langer R., Current status and future potential of transdermal drug delivery, Nature Reviews Drug Discovery, 3: 115-124, 2004.
742. Stevens, M., Qanadilo, H., Langer, R., and Shastri, V., A rapid-curing alginate gel system: utility in periosteum-derived cartilage tissue engineering, Biomaterials, 25: 887-894, 2004.
743. Pouliot, R., Azhari, R., Qanadilo, H.F., Mahmood, T., Triantafyllou, S. and Langer R., Tissue engineering of fish skin: Behavior of fish cells on PEGT/PBT copolymers in relation to the composition of the polymer substrate as an initial step in constructing a robotic/living tissue hybrid, Tissue Engineering, 10: 7-21, 2004.
744. Shastri, V.P., Padera, R.F., Tarcha, P.J. and Langer, R., A preliminary report on the biocompatibility of OrthoCure photopolymerization anhydride networks, Biomaterials, 25: 715-721, 2004.
745. Grayson, A., R., Johnson, A., Flynn, N., Li, Y., Cima, M., Langer, R., A bioMEMS review: MEMS technology for physiologically integrated devices, Proceedings of the IEEE, 92: 6-21, 2004.

746. Radisic, M., Yang, M., Boublik, J., Cohen, R., Langer, R., Freed, L., Vunjak-Novakovic, G., Medium perfusion enables engineering of compact and contractile cardiac tissue, Am. J. Physiol. Heart Cir Physiol, 286: H507-H516, 2004.
747. Meinel, L., Kareourgiou, V., Fajardo, R., Snyder, B., Shinde-Patil, V., Zichner, L., Kaplan, D., Langer, R. and Vunjak-Novakovic, G., Bone tissue engineering using human mesenchymal stem cells: Effects of scaffold material and medium flow, Annals of Biomed. Eng., 32: 112-122, 2004.
748. Colombo, G., Langer, R. and Kohane, D.S., Effect of excipient composition on the biocompatibility of bupivacaine-containing microparticles at the sciatic nerve, Journal of Biomed. Mats. Rsch., 68A: 651-659, 2004.
749. Peppas, N. and Langer, R., Origins and development of biomedical engineering within chemical engineering, AIChE J., 50: 536-546, 2004.
750. Stevens, M., Flynn, N., Wang, C., Tirrell, D. and Langer, R., Coiled-coil peptide based assembly of gold nanoparticles, Adv. Materials, 16: 915-918, 2004.
751. Little, S.R., Lynn, D.A., Ge, Q., Anderson, D.G., Puram, S., Chen, J., Eisen, H.N., Langer, R., Poly-β amino ester containing microparticles enhance the activity of non-viral genetic vaccines, PNAS, 101: 9534-9539, 2004.
752. Burdick, J., Khademhosseini, A. and Langer, R., Fabrication of gradient hydrogels using a microfluidics/photopolymerization process, Langmuir, 20: 5153-5156, 2004.
753. Jia, X., Burdick, J., Kobler, J., Clifton, R., Rosowski, J., Zeitels, S and Langer, R., Synthesis and characterization of *in Situ* crosslinkable hyaluronic acid-based hydrogels with potential application for vocal fold regeneration, Macromolecules, 37: 3239-3248, 2004.
754. Khademhosseini, A., Jon, S., Suh, K.Y., Tran, T., Eng, G., Yeh, J., Seong, J. and Langer, R., Direct patterning of protein- and cell-resistant polymeric monolayers and microstructures, Advanced Materials, 15: 1995-2000, 2004.
755. Suh, K.Y., Khademhosseini, A., Yang, J.M., Eng, G. and Langer, R., Soft lithographic patterning of hyaluronic acid on hydrophilic substrates using molding and printing, Advanced Materials, 16: 584-588, 2004.
756. Wang, C., Ge, Q., Ting, D., Nguyen, D., Shen, H., Chen, J., Eisen, H., Heller, J., Langer, R. and Putnam, D., Molecularly engineered poly(ortho ester) microspheres for enhanced delivery of DNA vaccines, Nature Materials, 3: 190-196, 2004.
757. Langer, R. and Tirrell, D., Designing materials for biology and medicine, Nature, 428: 487-492, 2004.
758. Qi, Y., Zhao, G., Liu, D., Shriver, Z., Sundaram, M., Sengupta, S., Venkataraman, G., Langer, R. and Ram Sasisekharan, Delivery of therapeutic levels of heparin and low-molecular-weight heparin through a pulmonary route, PNAS, 101: 9867-9872, 2004.
759. Suh, K., Khademhosseini, A., Eng, G. and Langer, R., Single nanocrystal arrays on patterned poly(ethylene glycol) copolymer microstructures using selective wetting and drying, Langmuir, 20: 6080-6084, 2004.
760. Khademhosseini, A., Suh, K.Y., Yang, J.M., Eng, G., Yeh, J., Levenberg, S. and Langer, R., Layer-by-layer deposition of hyaluronic acid and poly-L-lysine for patterned cell co-cultures, Biomaterials, 25: 3583-3592, 2004.
761. Thomas, T., Kohane, D., Wang, A. and Langer, R., Microparticulate formulations for the controlled release of interleukin-2, J. of Pharm. Sci., 93: 1100-1109, 2004.
762. Anderson, D.G., Levenberg, S. and Langer, R., Nanoliter-scale synthesis of arrayed biomaterials and application to human embryonic stem cells, Nature Biotech, 22: 863 – 866, 2004
763. Jia, X., Colombo, G., Padera, R., Langer, R. and Kohane, D.S., Prolongation of sciatic nerve blockade by *in situ* crosslinked hyaluronic acid, Biomaterials, 25: 4797-4804, 2004.
764. Grayson, A., Cima, M. and Langer, R., Molecular release from a polymeric microreservoir device: Influence of chemistry, polymer swelling, and loading on device performance, J. Biomed. Mats. Rsch, 69: 502-512, 2004.
765. Yue, I., Poff, J., Cortes, M.E., Sinisterra, R., Faris, C.B., Hildgen, P., Langer, R. and Shastri, R., A novel polymeric chlorhexidine delivery device for the treatment of periodontal disease, Biomaterials, 25: 3743-3750, 2004.
766. Berry, D., Lynn, D.M., Sasisekharan, R. and Langer, R., Internalized heparin using poly(β-amino ester)s promote cellular uptake of heparin and cancer cell death, Chemistry & Biology, 11: 487-798, 2004.
767. Chen, P.C., Park, Y.J., Chang, L.C., Kohane, D.S., Bartlett, R.H., Langer, R. and Yang, V.C., Injectable microparticle-gel system for prolonged and localized lidocaine release. I: *In vitro* characterization, Journal of Biomedical Materials Research, 412-419, 2004.
768. Lavik, E. and Langer, R., Tissue engineering: Current state and perspectives, Applied Microbiol & Biotech., 65: 1-8, 2004.

769. Voskerician, G., Shawgo, R.S., Hiltner, A.P., Anderson, J.M., Cima, M.J. and Langer, R., *In vivo* inflammatory and wound healing effects of gold electrode voltammetry for MEMS micro-reservoir drug delivery device, IEEE Trans. Biomed. Eng., 51: 627-635, 2004.
770. Chau, Y., Tan, F. and Langer, R., Synthesis and characterization of dextran-peptide-methotrexate conjugates for tumor targeting via mediation by matrix-metalloproteinase II and matrix-metalloproteinase IX, Bioconjug. Chemistry, 15: 931-941, 2004.
771. Wang, C., Flynn, N. and Langer, R., Controlled structure and properties of thermoresponsive nanoparticle-hydrogel composites, Adv. Materials, 16: 1074-1079, 2004.
772. Chen, P.C., Kohane, D.S., Park, Y.J., Bartlett, R.H., Langer, R. and Yang, V.C., Injectable microparticle-gel system for prolonged and localized lidocaine release. II: *In vivo* anesthetic effects, J. Biomed. Mats. Rsch, 70: 459-466, 2004.
773. Ijima, H., Wang, Y. and Langer, R., Spheroid formation and expression of liver specific functions of primary rat hepatocytes co-cultured with bone marrow cells, Biochem. Eng. Journal, 20: 223-228, 2004.
774. Khademhosseini, A., Suh, K.Y., Jon, S., Eng, G., Yeh, J., Chen, G.J. and Langer, R., A simple soft lithographic approach to fabricate patterned microfluidic channels, Analyt. Chem, 76: 3675-3681, 2004.
775. Stevens, M., Qanadilo, H., Langer, R., Martin, I. and Shastri, V.P., FGF-2 in combination with TGF-b1 enhances periosteum derived chondrogenesis *in vitro*, J. Orthop. Res., 22: 1114-1119, 2004.
776. Moss, J.D. and Langer, R., Drug Delivery Mechanisms, in Principles of Pharmacology: The pathophysiologic basis of drug therapy, 2005, 781-787, E. Golan, ed.in chief, Lippincott Williams & Williams, Baltimore.
777. Meinel, L., Hofmann, S., Kareourgiou, V., Kirker-Head, C., Zichner, L., McCool, J.C., Langer, R., Vunjak-Novakovic, G. and Kaplan, D., The inflammatory reponses to silk films *in vivo* and *in vitro*, Biomaterials, 26: 147-155, 2005.
778. LaVan, D., Padera, R., Friedmann, T., Sullivan, J., Langer, R., and Kohane, D., *In vivo* evaluation of tetrahedral amorphous carbon, Biomaterials, 26: 465-473, 2005.
779. Pfeifer, B., Burdick, J. and Langer, R., Formulation and surface modification of poly(ester-anhydride) micro- and nanospheres, Biomaterials, 26: 117-124, 2005.
780. Chen, T., Langer, R., Weaver, J. An in vitro system for measuring the transdermal voltage and molecular flux across the skin in real time, in Electrically Med. Del. of Molec. to Cells: Electrochemotherapy, Electrogenetherapy, and Transderm. Del. by Electroporation, Meth. in Molec. Med. Series, M. Jaroszeski, R. Gilbert, Heller, R., eds., Totowa, N.J., The Humana Press, Inc., in press.
781. Marini, R., Stevens, M., Langer, R. and Shastri, V.P., Hydraulic elevation of the periosteum: A novel technique for periosteal harvest, J. Invest. Surg., in press.
782. Domb, A., Langer, R. Biodegradable polyanhydrides. Poly. Chem., Biodegrad. & Toxicity, in press.
783. Tang, H., Mitragotri, S., Blankschtein, D., Langer, R. Applications of Low-Frequency Sonophoresis in Drug Delivery. Encl. Of Pharm. Tech., Swarbrick, J., Boylan, J., Eds., in press.
784. Mahmood, T. and Langer, R., Adhesion-mediated signal transduction in human articular chondrocytes: The influence of biomaterial chemistry and tenascin-C, Expericmental Cell Research, in press.
785. Meinel, L., Kaplan, D., Langer, R, Karageorgious, V, Zichner, L. and Vunjak-Novakovic, G., Engineering cartilage-like tissue using human mesenchymal stem cells and silk protein scaffolds, Biotechnology and Bioengineering, in press.
786. Lynn, D., Anderson, D.G., Akinc, A. and Langer, R., "Degradable poly(β-amino ester)s for gene delivery", Polymeric Gene Delivery: Principles And Applications, ed: Mansoor M. Amiji, CRC Press, in press.
787. Berry, D., Claypool, S.M., Blumberg, R.S., Kwan, C-P., Colgan, S.P., Langer, R.S. and Sasisekharan, R., dFGF2 and FGF7 enhance a FGF1 mediated autocrime signal to promote protective effects in inflammatory bowel disease, Gastroenterology, in press.
788. Grayson, A., Voskerician, G., Lynn, A., Anderson, J., Cima, M. and Langer R., Differential degradation rates *in vivo* and *in vitro* of biocompatibile poly(lactic acid) and poly(glycolic acid) homo- and co-polymers for a polymeric drug-delivery microchip, J of Biomat. Science, in press.
789. Stevens, M., Marini, R., Martin, I., Langer, R. and Shastri, V., FGF-2 enhances TGF-beta1-induced periosteal chondrogenesis, J. of Orthopaedic Rsch., in press.
790. Wang, P, Langer, R., and Brem, H., Biodegradable polymers for brain tumor therapy, in Polymeric Drug Delivery Systems, in press, Glen S. Kwon, ed. Marcel Dekker, Inc.

791. Johnson, A.M., Sadoway, D.R., Cima, M.J. and Langer, R., Design and testing of an impedance-based sensor for monitoring drug delivery, J. of the Electrochem. Soc., in press.
792. Lavik, E.B., Klassen, H., Warfvinge, K., Langer, R and Young, M.J., Fabrication of degradable polymer scaffolds to direct the integration and differentiation of retinal progenitors, Biomaterials, in press.
793. Grayson, A.C.R., Cima, M. and Langer, R., Size and temperature effects on poly(lactic acid-co-glycolic acid) degradation and microreservoir device performance, Biomaterials, in press.
794. Seidel, J., Pei, M., Gray, M.L., Langer, R., Freed, L. and Vunjak-Novakovic, G., Long term culture of tissue engineerd cartilage in a perfused chamber with mechanical stimulation, Biorheology, in press.
795. Jaffar, S., Nam, K.T., Khademhosseini, A., Xing, J. and Langer, R., Layer-by-layer surface modification and patterned electrostatic deposition of quantum dots, Nano Letters, in press.
796. Kushner, J., Blankschtein, D. and Langer, R., Experimental demonstration of the existence of highly permeable localized transport regions in low-frequency sonophoresis, J. of Pharma. Sci, in press.
797. Sinisterra, R., Shastri, V., Langer, R. Preparation of PLGA microspheres containing chlorhexidine its inclusion compounds with cyclodexrins. Journal of Controlled Release, submitted.
798. Meinel, L., Kareourgiou, V., Hofmann, S., Fajardo, R., Snyder, B., Li, C., Zichner, L., Langer, R., Vunjak-Novakovic, G. and Kaplan, D., Engineering bone-like tissue using human bone marrow stromal cells in 3D silk scaffolds, J. Biomed. Mat. Res., submitted.
799. Berry, D., Lynn, D.M., Berry, E., Sasisekharan, R. and Langer, R., Heparinase digestion of cell surface heparin/heparan sulfate-like glycosaminoglycans induce Burkitt's lymphoma cell death, Leukemia, submitted.
800. Peng, W., Anderson, D.G., Langer, R. and Sawicki, J., Nanoparticle-delivered suicide gene inhibits prostate tumor growth, Cancer Research, submitted.
801. Haining, W.N., Anderson, D. G., Little, S.R., von Bergwelt-Baildon, M., Cardoso, P.A., Alves, P., Kosmatopoulos, K., Nadler, L., Langer, R. and Kohane, D.S., pH-triggered microparticles for peptide vaccination, J. Immunology, submitted.
802. Khalessi, A., Wang, P., Langer, R., Brem, H., Treatment of malignant brain tumors with controlled release local delivery polymers, submitted.
803. Shawgo, R., Voskerician, G., Duc, H.L.H., Li, Y., Lynn, A., McEwan, M., Langer, R., Anderson, J. and Cima, M., Repeated *in vivo* electrochemical activation of MEMS drug delivery device and the biological effects, J. of Biomed. Mats. Rsch., submitted.
804. Li, Y., Shawgo, R., Tyler, B., Henderson, P.T., Vogel, J.S., Rosenberg, A., Storm, P.B., Langer, R., Brem, H. and Cima, M.J., *In vivo* release from a drug delivery MEMS device, J. Cont. Release, submitted.
805. Anderson, D., Burdick, J. and Langer, R., Smart biomaterials, Science, submitted.
806. Lee, P, Mitragotri S., Langer, R., Shastri, V., Role of n-methyl pyrrolidone in the enhancement of transdermal transport. Journal of Pharma. Rsch, submitted

BOOKS

1. Langer, R., Wise, D. eds, Medical Applications of Controlled Release, Vol. I: Classes of Systems, CRC Press, Boca Raton, FL, 1984.
2. Langer, R., Wise, D. eds, Medical Applications of Controlled Release. Vol. II: Application and Evaluation, CRC Press, Boca Raton, FL, 1984.
3. Chasin, M., Langer, R. eds., Biodegradable Polymers for Drug Del., Marcel Dekker, NY 1990.
5. Steiner, R., Weisz, P., Langer, R. Angiogenesis, Birkhauser (AG), Basel, Switzerland, 1992.
6. C.A. Vacanti, J.P.Vacanti, R. Langer, Polymers of Biological and Biomedical Significance, Vol. 540, 17-34, American Chemical Society Symposium Series, New York, 1993.
7. Peppas, N. Langer, R. Advances in Polymer Science, Vol. 107, Biopolymers I, Springer-Verlag Publishing Co., New York, 1993.
8. Cohen, S., Langer, R. Liposomes in Immunology: Concepts and Applications, ImmunoMethods, Academic Press, California, 1994.
9. Cleland, J., Langer, R. Formulations and Delivery of Proteins and Peptides, American Chemical Society, Volume 567, Washington, 1994.
10. Peppas, N., Langer, R. Biopolymers II, Springer-Verlag, Berlin, Germany, 1995.
11. Lanza, R., Chick, W., Langer, R. Textbook of Tissue Engineering, Springer-Verlag, Berlin, Germany, 1996.
12. Atala, A., Mooney, D., Vacanti, J., Langer, R. Synthetic Biodegradable Polymer Scaffolds, Birkhauser, Boston, MA, 1997
13. Lanza, R., Langer, R., Vacanti, J. eds. Principles of Tissue Engineering, Second Edition, Academic Press, San Diego, CA, 2000.

COURSE TEXTS

1. Cincotta, D., Cole, K., Langer, R. Group School Chemistry Curriculum, 167 pages (1972).
2. Thilly, W., Langer, R., Laboratory in Applied Biology, 430 pages (1978).
3. Langer, R., Thilly, W. Analytical Practices in Biochemistry, 290 pages (1979).

PATENTS

US PATENTS

1. US Patent 4,164,560: Folkman, J., Langer, R., Systems for the Controlled Release of Macromolecules.
2. US Patent 4,341,869: Langer, R., Linhardt, R., Cooney, C., Galliher, P., Process of Producing of Heparinase.
3. US Patent 4,357,312: Hsieh, D., Langer, R., Method of Making Prolonged Release Body.
4. US Patent 4,373,023: Langer, R., Linhardt, R., Cooney, C., Galliher, P., Flanagan, M., Klein, M., Process for Neutralizing Heparin.
5. US Patent 4,391,797: Folkman, J., Langer, R., Systems for the Controlled Release of Macromolecules.
6. US Patent 4,396,762: Langer, R., Linhardt, R., Cooney, C., Fitzgerald, Grant, A., Heparinase Derived Anticoagulants.
7. US Patent 4,414,147: Klibanov, A., Langer, R., Methods of Decreasing the Hydrophobicity of Fibroblast and other Interferons.
8. US Patent 4,443,545: Langer, R., Lindhardt, R., Cooney, C., Galliher, P., A Process for Producing Heparinase.
9. US Patent 4,501,116: Folkman, M., Taylor, S., Langer, R., Inhibition of Angiogenesis.
10. US Patent 4,591,496: Cohen, J., Siegel, R., Langer, R., Process for Making Systems for The Controlled Release of Macromolecules.
11. US Patent 4,638,045: Kohn, J., Langer, R., Non-Peptide Polyamino Acid Bioerodible Polymers.
12. US Patent 4,657,543: Kost, J., Langer, R., Ultrasonically Modulated Polymeric Devices for Delivery Composition.
13. US Patent 4,666,855: Yang, V., Langer, R., Rapid Method for Determining the Isoelectric Point for Amphoteric Molecules.
14. US Patent 4,732,155: Zetter, B., Langer, R., Implantable Chemoattractant System.
15. US Patent 4,753,652: Levy, R., Langer, R., Biomaterial Implants which Resist Calcification.
16. US Patent 4,757,128: Domb, A., Langer, R., High Molecular Weight and Preparation of Polyanhydride Thereof.
17. US Patent 4,767,402: Kost, J., Levy, D., Langer, R., Ultrasound Enhancement of Transdermal Drug Delivery.
18. US Patent 4,779,806: Langer, R., Kost, J., Ultrasonically Modulated Polymeric Devices For Delivering Compositions.
19. US Patent 4,780,212: Kost, J., Langer, R., Ultrasound Enhancement of Membrane Permeability.
20. US Patent 4,789,724: Domb, A., Langer, R., Preparation of Anhydride Copolymers.
21. US Patent 4,795,703: Hannon, R., Thompson, R., Langer, R., Folkman, J., Heparinase Assay.
22. US Patent 4,806,621: Kohn, J., Langer, R., Biocompatible, Bioerodible, Hydrophobic, Implantable Polyimino carbonate article.
23. US Patent 4,846,786: Freed, L. B., Kadam, J., Drinker, P.A., Thebeau, J., Langer, R., Bioreactor Containing Suspended, Immobilized Species.
24. US Patent 4,857,311: Domb, A., Langer, R., Polyanhydrides with Improved Hydrolytic Degradation Properties.
25. US Patent 4,861,627: Mathiowitz, E., Langer, R., Preparation of Multiwall Polymeric Microcapsules.
26. US Patent 4,863,611: Bernstein, H., Langer, R., Extracorporeal Reactors Containing Immobilized Species.
27. US Patent 4,863,735: Kohn, J., Niemi, S., Fox, J., Langer, R., Biodegradable Polymeric Drug Delivery System with Adjuvant Activity.
28. US Patent 4,880,622: Allcock, H., Austin, P., Kwon, S., Laurencin, C., Langer, R., Water-Soluble Phosphazene Polymers Having Pharmacological Applications.
29. US Patent 4,883,666: Sabel, B., Freese, A., Saltzman, W., Langer, R., Controlled Drug Delivery System for Treatment of Neural Disorders.
30. US Patent 4,886,870: D'Amore, P., Leong, K., Langer, R., Bioerodible Articles Useful as Implants and Prostheses Having Predictable Degradation Rates.
31. US Patent 4,888,176: Langer, R., Mathiowitz, E., Domb, A., Laurencin, C., Controlled Drug Delivery High Molecular Weight Polyanhydrides.
32. US Patent 4,891,225: Langer, R., Rosen, H., Bioerodible Polyanhydrides for Controlled Drug Delivery.
33. US Patent 4,898,734: Mathiowitz, E., Langer, R., Warshawsky, A., Edelman, E., Polymer Composite for Controlled Release or Membrane Formation.
34. US Patent 4,900,556: Wheatley, M., Langer, R., Eisen, H., System for Delayed and Pulsed Release of Biologically Active Substances.

35. US Patent 4,906,474: Langer, R., Rosen, H., Linhardt, R., Leong, K.W., Bioerodible Polyanhydrides for Controlled Drug Delivery.
36. US Patent 4,916,204: Domb, A., Langer, R., Giannos, S., Kothari, R., Mathiowitz, E., Pure Polyanhydride from Dicarboxylic Acid and Coupling Agent.
37. US Patent 4,921,757: Wheatley, M., Langer, R., Eisen, H., System for Delayed and Pulsed Release of Biologically Active Substances.
38. US Patent 4,933,185: Wheatley, M., Langer, R., Eisen, H., System for Controlled Release of Biologically Active Compounds.
39. US Patent 4,933,431: Domb, A., Ron, E., Giannos, S., Kothari, R., Langer, R., One Step Preparation of Poly(amide-anhydride).
40. US Patent 4,946,929: D'Amore, P., Leong, K., Langer, R., Bioerodible Articles Useful as Implants and Prostheses Having Predictable Degradation Rates.
41. US Patent 4,948,587: Kost, J., Langer, R., Ultrasound Enhancement of Transbuccal Drug Delivery.
42. US Patent 4,952,406: Brown, L., Ghodsian, F., Langer, R., Feedback Controlled Release.
43. US Patent 4,994,443: Folkman, M., Taylor, S., Langer, R., Inhibition of Angiogenesis.
44. US Patent 5,001,116: Folkman, M., Taylor, S., Langer, R., Inhibition of Angiogenesis (Heparin - Corticosteroids).
45. US Patent 5,010,167: Ron. E., Staubli, A., Langer, R., Poly(amide-imide-Co-Anhydrides) for Biological Applications.
46. US Patent 5,019,034: Weaver, J, Powell, K., Langer, R., Control of Transport of Molecules Across Tissue Using Electroporation.
47. US Patent 5,019,372: Folkman, J., Langer, R., Hsieh, D., Magnetically Modulated Polymeric Drug Release System.
48. US Patent 5,019,379: Domb, A., Langer, R., Unsaturated Polyanhydrides.
49. US Patent 5,041,138: Vacanti, J., Vacanti, C., Langer, R., Neomorphogenesis of Cartilage *in vivo* from Cell Culture.
50. US Patent 5,076,208: Zohar, Y., D'Emanuele, A., Langer, R., Ultrasound-Mediated Administration of Compounds into Aquatic Animals.
51. US Patent 5,100,668: Edelman, E., Klagsburn, M., Mathiowitz, E., Langer, R., Controlled Release Systems Containing Heparin and Growth Factors.
52. US Patent 5,114,719: Sabel, B., Freese, A., Saltzman, W., Langer, R., Extended Drug Delivery of Small, Water Soluble Molecules.
53. US Patent 5,122,367: Ron, E., Chasin, M., Turek, T., Langer, R., Polyanhydride Bioerodible Controlled Release Implants for Administration of Stabilized Growth Hormone.
54. US Patent 5,128,420: Domb, A., Langer, R., Golomb, G., Mathiowitz, E., Laurencin, C., Method of Making Hydroxamic Acid Polymers from Primary Amide Polymers.
55. US Patent 5,149,543: Cohen, S., Bano, C., Visscher, K., Chow, M., Allcock, H., Langer, R., Ionically Cross-linked Polymeric Microcapsules.
56. US Patent 5,178, 864: Langer, R., Lees, R., Labeque, R., Mullon, C., Lipoptotein removal by soluble enzymes.
57. US Patent 5,200,181: Soltys, P., Mullon, C., Langer, R., Oral Bilirubin Therapy.
58. US Patent 5,232,696: Lees, R., Langer, R., Mullon, C., Conlon, H.D., Reduction of low-density lipoprotein in biological fluids.
59. US Patent 5,286,763: Laurencin, C., Gerhardt, T., Domb, A., Langer, R., Hayes, W., Bioerodible polymers for drug delivery in bone.
60. US Patent 5,308,701: Cohen, S., Bano, C., Visscher, K., Chow, M., Allcock, H., Langer, R., Ionically Cross-linked Polymeric Microcapsules.
61. US Patent 5,330,768: Park, T., Cohen, S., Langer, R., Controlled Drug Delivery Using Polymer/Pluronic Blends.
62. US Patent 5,356,630: Laurencin, C., Lucas, P., Langer, R., Domb, A., Syftestad, G., Glowacki, J., Delivery System for Controlled Release of Bioactive Factors
63. US Patent 5,389,539: Sasisekharan, R., Lohse, D., Cooney, C., Linhardt, R., Langer, R., Purification of heparinase I, II, and III from flavobacterium heparinum.
64. US Patent 5,399,665: Barrera, D., Langer, R., Lansbury, P., Vacanti, J., Biodegradable polymers for cell transplantation.
65. US Patent 5,417,863: Varady, L., Afeyan, N., Langer, R., Shefer, S., Quantitative measurement of LDL

66. US Patent 5,458,140: Epstein, J., Epstein, D., Kost, J., Langer, R., Enhancement of Transdermal Monitoring Applications with Ultrasound and Chemical Enhancers.
67. US Patent 5,487,390: Cohen, S., Andrianov, A., Wheatley, M. Allcock, H, Langer, R., Gas-filled polymeric microbubbles for ultrasound imaging.
68. US Patent 5,494,682: Cohen, S., Bano, C., Chow, M., Visscher, K., Allcock, H., Langer, R., Ionically Cross-linked Polymeric Microcapsules.
69. US Patent 5,500,161: Andrianov, A., Langer, R., Method for Making Hydrophobic Polymeric Microparticles.
70. US Patent 5,512,600: Mikos, A., Langer, R., Preparation of Bonded Fiber Structures for Cell Implantation.
71. US Patent 5,514,378: Mikos, A., Sarakinos, G., Vacanti, J., Langer, R., Cima, L., Biocompatible polymer structures and methods of preparation of three-dimensional membrane structures.
72. US Patent 5,543,158: Gref, R., Minamitake, Y., Langer, R., Biodegradable Injectable Nanoparticles.
73. US Patent 5,545,409: Laurencin, C., Langer, R., Lucas, P., Domb, A., Glowacki, J., Syftestad, G., Delivery System for Controlled Release of Bioactive Factors.
74. US Patent 5,547,467: Pliquett, U., Prausnitz, M., Weaver, J., Langer, R., Method for rapid temporal control of molecular transport across tissue.
75. US Patent 5,651,986: Brem, H., Langer, R., Domb, A., Controlled Local Delivery of Chemotherapeutic Agents for Treating Solid Tumors.
76. US Patent 5,562,099: Cohen, S., Andrianov, A., Wheatley, M., Langer, R., Allcock, H., Monahan, T., Polymeric Microcapsules Containing Agents for Imaging.
77. US Patent 5,562,909: Allcock, H.R., Andrianov, A., Jenkins, S.A., Langer, R., Payne, L.G., Roberts, B.E., Visscher, K.B., Phosphazene Polyelectrolytes as Immunoadjuvants.
78. US Patent 5,565,215: Gref, R., Minamitake, Y., Langer, R., Biodegradable injectable particles for imaging.
79. US Patent 5,567,417: Sasisekharan, R., Nugent, M., Cooney, C., Moses, M., Langer, R., Method for Inhibiting Angiogenesis Using Heparinase.
80. US Patent 5,567,612: Vacanti, J., Langer, R., A Genitourinary Cell-Matrix Structure for Implantation Into a Human and a Method of Making.
81. US Patent 5,569,600: Sasisekharan, R., Lohse, D., Cooney, C., Linhardt, R., Langer, R., Purification, Composition and Specificity of Heparinese I, II and III from Flavobacterium Heparinum.
82. US Patent 5,578,325: Domb, A., Gref, R., Langer, R., Nanoparticles and Microparticles of Non-linear Hydrophilic-Hydrophobic Multiblock Copolymers.
83. US Patent 5,593,974: DeKeyser, J.-L., Edelman, E., Langer, R., Rosenberg, R., and Simons, M., Localized Oligonucleotide Therapy.
84. US Patent 5,601,835: During, M., Freeze, A., Langer, R., Sabel, B., Saltzman, W., Polymeric device for controlled drug delivery to the central nervous system.
85. US Patent 5,618,563: Berde, C., Langer, R. Biodegradable polymer matrices for sustained delivery of local anesthetic agents.
86. US Patent 5,619,421: Venkataraman, G., Sasisekharan, R., Bobba, R., Cooney, C., Langer, R. Computer-implemented process and computer system for estimating the three-dimensional shape of a ring-shaped molecule and of a portion of a molecule containing a ring-shaped structure.
87. US Patent 5,626,862: Brem, H., Langer, R., Domb, A., Controlled local delivery of chemotherapeutic agents for treating solid tumors.
88. US Patent 5,629,009: Laurencin, C., Lucas, P., Syftestad, G., Domb, A., Glowacki, J., Langer, R., Delivery System for Controlled Release of Bioactive Factors.
89. US Patent 5,633,836: Langer, R., Johnson, M. Accelerated development time-delayed message system.
90. US Patent 5,654,381: Hrkach, J., Langer, R., Lotan, N., Functionalized polyester graft copolymers.
91. US Patent 5,667,491: Pliquette, U., Prausnitz, M., Weaver, J., Langer, R. Method for rapid temporal control of molecular transport across tissue.
92. US Patent 5,696,175: Mikos, A., Langer, R., Preparation of bonded fiber structures for cell implantation.
93. US Patent 5,700,485: Berde, C., Langer, R., Prolonged nerve blockade by the combination of local anesthetic and glucocoticoid.
94. US Patent 5,714,376: Sasisekharan, R., Moremen, K., Cooney, C., Langer, R., Vickers, R., Heparinase Gene From Flavobacterium Heparinum.
95. US Patent 5,716,404: Vacanti, J., Atala, A., Mooney, D., Langer, R., Breast Tissue Engineering.

96. US Patent 5,718,921 Mathiowitz, E., Mullon, C.J.P., Domb, A., Langer, R., Microspheres comprising polymer and drug dispersed there within.
97. US Patent 5,736,372: Vacanti, J, Vacanti, C., and Langer, R., Biodegradable synthetic polymeric fibrous matrix containing chondrocytes for *in vivo* production of a cartilaginous structure.
98. US Patent 5,749,847: Zewert, T., Pliquett, U., Langer, R., Weaver, J.C., Delivery of Nucleotides into Organisms by Electroporation.
99. US Patent 5,759,830: Vacanti, J., Langer, R., Three-Dimensional Fibrous Scaffold containing Attached Cells for Producing Vascularized Tissue *in vivo*.
100. US Patent 5,762,904: Okada, J., Cohen, S., Langer, R, Oral Delivery of Vaccines Using Polymerized Liposomes.
101. US Patent 5,770,193: Vacanti, J., Langer, R., Preparation of Three-Dimensional Fibrous Scaffold for Attaching Cells to Produce Vascularized Tissue *in vivo*.
102. US Patent 5,770,417: Vacanti, J., Langer, R., Three-Dimensional Fibrous Scaffold containing Attached Cells for Producing Vascularized Tissue *in vivo*.
103. US Patent 5,783,567, Hedley, M., Curley, J., Langer, R., Microparticles for delivery of nucleic acid.
104. US Patent 5,797,898, Santini, J., Michigan, J., Cima, M., Langer, R., Microchip Drug Delivery Devices.
105. US Patent 5,804,178, Vacanti, J., Langer, R., Johnson, L., Implantation of Cell-Matrix Structure Adjacent Mesentery, Omentum or Peritoneum Tissue.
106. US Patent 5,814,599: Mitragotri, S., Blankschtein, D., Langer, R., Transdermal Delivery of Encapsulated Drugs.
107. US Patent 5,817,328: Gresser, J., Wise, D., Klibanov, A., Langer, R., Material for Buffered Resorbable Internal Fixation Devices and Method for Making Same.
108. US Patent 5,830,726: Sasisekharan, R., Moremen, K., Cooney, C., Zimmerman, J., Langer, R., Vickers, R., Method for obtaining a modified heparinase gene.
109. US Patent 5,837,680: Moses, M., Langer, R., Weidershain, D., Wu, I., Sytkowkski, A., Pharmaceutical compositions comprising troponin subunits, fragments and analogs thereof and methods of their use to inhibit angiogenesis.
110. US Patent 5,837,752: Shastri, V., Tarcha, P., Langer, R. Semi-interpenetrating polymer networks.
111. US Patent 5,843,741: Wong, J., Ingber, D., Langer, R. Method for altering the differentiation of anchorage dependent cells on an electrically conducting polymer.
112. US Patent 5,846,565: Brem, H., Langer, R., Domb, A., Controlled Local Delivery of Chemotherapeutic Agents for Treating Solid Tumors.
113. US Patent 5,851,833: Atala, A., Vacanti, J., Freeman, M., Langer, R., Neomorphogenesis of Urological Structures *in vivo* from Cell Culture.
114. US Patent 5,855,913: Hanes, J., Edwards, D., Evora, C., Langer, R., Particles Incorporating Surfactants for Pulmonary Drug Delivery.
115. US Patent 5,874,064: Edwards, D., Caponetti, G., Hrkach, J., Lotan, N., Hanes, J., Jebria, A., Langer, R. Aerodynamically light particles for pulmonary drug delivery.
116. US Patent 5,902,599: Anseth, K., Langer, R. and Shastri, V., Biodegradable Polymer Networks for Use in Orthopedic and Dental Applications.
117. US Patent 5,911,223: Weaver, J., Zewert, T., Pliquett, U., Vanbever, R., Prausnitz, M., Chen, T., Cullander, C., Guy, R., Langer, R., Introduction of Modifying Agents into Skin by Electroporation.
118. US Patent: 5,912,017: Mathiowitz, E., Langer, R. Multiwall Polymeric Microspheres.
119. US Patent 5,922,340: Berde, C., Curley, J., Langer, R., High Load Formulations and Methods for Providing Prolonged Local Anesthesia.
120. US Patent 5,947,921: Johnson, M., Mitragotri, S., Blankschtein, D., Langer, R. Chemical and physical enhancers and ultrasound for transdermal drug delivery.
121. US Patent 5.985,309: Edwards, D., Langer, R. Preparation of particles for inhalation.
122. US Patent 5,985,320: Edwards, D., Langer, R. Materials and methods for enhancing cellular internalization.
123. US Patent 6,002,961: Mitragotri, S., Blankstein, D., Langer, R. Transdermal Protein Delivery Using Low Frequency sonophoresis.
124. US Patent 6,004,534: Chen, H., Langer, R. Targeted polymerized liposomes for improved drug delivery.
125. US Patent 6,007,845: Domb, A., Gref, R., Minamitake, Y., Peracchia, M., Bernstein, H., Langer, R., Nanoparticles and Microparticles of Non-Linear Hydrophilic-Hydrophobic Multiblock Copolymers.

126. US Patent 6,018,678: Mitragotri, S., Blankschtein, D., Langer, R., Transdermal protein delivery or measurements using low-frequency sonophoresis.
127. US Patent 6,025,331: Moses, M., Langer, R., Weidershain, D., Wu, I., Sytkowkski, A., Pharmaceutical Compositions Comprising Troponin Subunits, Fragments and Analogs Thereof and Methods of their Use to Inhibit Angiogenesis.
128. US Patent 6,041,253: Kost, J., Pliquett, U., Mitragotri, S., Langer, R., Effect of Electric Field and Ultrasound for Transdermal Drug Delivery
129. US Patent 6,046,187: Berde, C., Curley, J., Langer, R., Formulations and Methods for Providing Prolonged Local Anesthesia.
130. US Patent 6,060,082: Chen, H., Langer, R. Polymerized liposomes targeted to M cells and useful for oral or mucosal drug delivery.
131. US Patent 6,095,148: Shastri, V., Schmidt, C., Langer, R., Vacanti, J., Neuronal stimulation using electrically conducting polymers.
132. US Patent 6,099,730: Ameer, G., Langer, R., Rupnick, M., Ploegh, H., Grovender, E., Apparatus and method for treating whole blood comprising concentric cylinders defining an annulus therebetween.
133. US Patent 6,123,727: Vacanti, C., Cao, Y., Langer, R., Vacanti, J., Paige, K., Upton, J., Tissue engineered tendons and ligaments.
134. US Patent 6,123,861: Santini, J., Langer, R., Cima, M., Fabrication of microchip drug delivery devices.
135. US Patent 6,136,295: Edwards, D., Caponetti, G., Hrkach, J., Lotan, N., Hanes, J., Ben-Jebria, A., Langer R., Aerodynamically light particles for pulmonary drug delivery.
136. US Patent 6,149,864: Dillow, A., Langer, R., Foster, N., Hrkach, J., Supercritical Fluid Sterilization Method.
137. US Patent 6,160,084: Langer, R., Lendlein, A., Schmidt, A., Grablowitz, H. Biodegradable Shape Memory Polymers.
138. US Patent 6,174,952: Hekal, I, Langer, R., Klibanov, A., Mathiowitz, E., Monolithic composition having a water absorption material.
139. US Patent 6,177,183: Hekal, I., Langer, R., Klibanov, A., Mathiowitz, E., Monolithic composition having an activation material.
140. US Patent 6,190,315: Kost, J., Mitragotri, S., Langer, R., Sonophoretic enhanced transdermal transport.
141. US Patent 6,190,893: Shastri, V., Rahman, N., Martin, I., Langer, R., Electroactive materials for stimulation of biological activity of bone marrow stromal cells.
142. US Patent 6,194,079: Hekal, I., Langer, R., Klibanov, A., Mathiowitz, E., Monolithic composition having an absorbing material.
143. US Patent 6,197,229:Ando, S., Putnam, D., Langer, R., Method for supercoiled DNA content microspheres.
144. US Patent 6,214,387 Berde, C., Langer, R., Hu, D., Biodegradable polymer matrices for sustained delivery of local anesthetic agents.
145. US Patent 6,217,863:Godavarti, R., Sasisekharan, R., Ernst, S., Venkataraman, G., Cooney, C., Langer, R., Rationally designed polysaccharide lyases from heparinase I.
146. US Patent 6,224,893: Langer, R., Elisseeff, J., Anseth, K., Sims, D., Semi-interpenetrating or interpenetrating polymer networks for drug delivery and tissue engineering.
147. US Patent 6,238,702: Berde, C., Langer, R., Curley, J., Castillo, J., High load formulations and methods for providing prolonged local anesthesia.
148. US Patent 6,241,771: Gresser, J., Trantolo, D., Langer, R., Lewandrowski, K., Klibanov, A., Wise, D., Resorbable interbody spinal fusion devices.
149. US Patent 6,254,854: Edwards, D., Caponetti, G., Hrkach, J., Lotan, N., Hanes, J., Langer, R., Ben-Jebria, A., Porous particles for deep lung delivery.
150. US Patent 6,254,890: Hirosue, S., Mueller, B., Langer, R., Mulligan, R., Sub-100nm biodegradable polymer spheres capable of transporting and releasing nucleic acids.
151. US Patent 6,262,183: Domb, A., Langer, R., Cravalho, E., Golomb, G., Mathiowitz, E., Laurencin, C., Hydroxamic acid polymers formed from primary amide polymers.
152. US Patent 6,281,015: Mooney, D., Langer, R., Vacanti, J., Localized Delivery of Factors Enhancing Survival of Transplanted Cells.
153. US Patent: 6,306,819: Rupnick, M., Langer, R., Folkman, J., Method for regulating size of vacularized normal tissue.

154. US Patent 6,309,635: Ingber, D., Langer, R., Vacanti, J., Seeding parenchymal cells into compression resistant porous scaffold after vascularizing in vivo.
155. US Patent 6,326,020: Kohane, D., Berde, C., Strichartz, G., Langer, R., Local anesthetic formulations.
156. US Patent 6,355,224: Shastri, V., Langer, R., Conductive Polymer Contrast Agent Compositions and Uses therefore.
157. US Patent RE37,053: Hanes, J., Edwards, D., Evora, C., Langer, R. particles incorporating surfactants for pulmonary drug delivery.
158. US Patent RE37, 410: Brem, H., Langer, R., Domb, A., Controlled Local Delivery of Chemotherapeutic Agents for Treating Solid Tumors.
159. US Patent 6,387,397: Chen, H., Langer, R. Polymerized liposomes targeted to M cells and useful for oral or mucosal drug delivery.
160. US Patent 6,388,043: Langer, R., Lendlein, A. Shape memory polymers.
161. US Patent 6,399,102: Edwards, D., Coponetti, G., Hrkach, J., Lotan, N., Hanes, J., Ben-Jebria, A., Langer, R. Aerodynamically light particles for pulmonary drug delivery.
162. US Patent: 6,403,558: Moses, M., Langer, R., Wiederschain, D., Wu, I., Sytkowski, A., Pharmaceutical Compositions Comprising Troponin Subunits, Fragments and Analogs Thereof and Methods of their use to inhibit Angiogenesis.
163. US Patent 6,419,945:Gresser, J., Trantolo, D., Langer, R., Klibanov, A., Wise, D., Buffered resorbable internal fixation devices and methods for making material therefore.
164. US Patent 6,426,339: Berde, C., Langer, R., Curley, J., Castillo, J., Formulations and methods for providing prolonged local anesthesia.
165. US Patent 6,447,752: Edwards, D., Caponetti, G., Hrkach, J., Lotan, N., Hanes, J., Langer, R., Ben-Jebria, A., Amorphous porous particles for deep lung delivery.
166. US Patent 6,471,993: Shastri, V.P., Martin, I., Langer, R., Seidel, J., Three-dimensional polymer matrices.
167. US Patent 6,491,666: Santini, J., Hutchinson, C., Uhland, S., Cima, M., Langer, R., Ausiello, D., Microfabricated Devices for the Delivery of Molecules into a Carrier Fluid.
168. US Patent 6,503,480: Edwards; D., Caponetti; G., Hrkach; J., Lotan, N., Hanes, J., Ben-Jebria; A., Langer, R., Aerodynamically light particles for pulmonary drug delivery
169. US Patent 6,537,256: Edwards; Santini, J., Hutchinson, C., Uhland, S., Cima, M., Langer, R., Ausiello, D., Microfabricated Devices for the Delivery of Molecules into a Carrier Fluid.
170. US Patent 6,548,002: Gresser, J., Trantolo, D., Langer, R., Lewandrowski, K., Klibanov, A., Wise, D., Method of making a biodegradable interbody spinal fusion devices.
171. US Patent 6,569,654: Shastri; V.P., Martin; I., Langer, R., Rahman, N., Electroactive materials for stimulation of biological activity of stem cells.
172. US Patent 6,582,717: Shastri, V., Yue, I., Sinisterra, R., Langer, R., Drug Delivery Composition and Devices.
173. US Patent 6,582,960: Freed, L., Martin, I., Langer, R., Vunjak-Novakovic, G., Use of Growth Factors and Hormones for Expansion of Mammalian Cells and Tissue Engineering.
174. US Patent 6,635,283: Edwards, D., Caponetti, G., Hrkach, J., Lotan, N., Hanes, J., Jebria, A., Langer, R. Aerodynamically light particles for pulmonary drug delivery.
175. US Patent 6,653,283: Moses, M., Langer, R., Weidershain, D., Wu, I., Sytkowkski, A., Pharmaceutical compositions comprising troponin subunits, fragments and analogs thereof and methods of their use to inhibit angiogenesis.
176. US Patent 6,689,608: Langer, R., Mikos, A., Ingber, D., Vacanti, J., Porous biodegradable polymeric materials for cell transplantation.
177. US Patent 6,692,911: Pack, D., Putnam, D., Langer, R., Cell delivery compositions.
178. US Patent 6,699,470: Ameer, G. and Langer, R., Mesh-gel constructs for cell delivery containing enzymes and/or enzyme inhibitors to control gel degradation.
179. US Patent 6,699,505: Shastri, V., Yue, I., Hildgen, P., Sinisterra, R., Langer, R., Method of increasing the efficacy of antibiotics by compexing with cyclodextrin.
180. US Patent 6,720,402: Langer, R. and Lendlein, A., Shape memory polymers.
181. US Patent 6,740,310: Edwards; D.A, Caponetti, G., Hrkach; J.S., Lotan, N., Hanes, J., Langer, R. and Ben-Jebria, A., Porous particles comprising excipients for deep lung delivery.

AUSTRALIAN PATENTS

182. Australia Patent 635,025: Vacanti, J., Langer, R., Neomorphogenesis of Cartilage *In vivo* from Cell culture.
183. Australia Patent 636,346: Johnson, L., Langer, R., Vacanti, J., Method of Implanting Large Cell Volume on a Polymeric Matrix.
184. Australia Patent 644,196: Langer, R., Lees, R., Labeque, R., Mullon, C., Lipoprotein Removal by Soluble Enzymes.
185. Australia Patent 645,620: Zohar, Y., Langer, R., Ultrasound-Mediated Administration of Compounds Into Aquatic Animals.
186. Australia Patent 652,744: Langer, R., Murray, J., Moses, M., Collagenase Inhibitors.
187. Australia Patent 659,482: Rosenberg, R., Simons, M., DeKeyser, J-l, Edelman, E., Langer, R., Localized Oligonucleotide Therapy.
188. Australian Patent 705,737: Berde, C., Langer, R., Prolonged nerve blockage by the combination of local anesthetics and glucocorticoids.
189. Australian Patent 720,275: Shastri, V.P., Schmidt, C., Langer, R., Vacanti, J., Neuronal stimulation using electrically conducting polymers.
190. Australian Patent 33084/99: Lendlein, A. and Langer, R., Shape Memory Polymers.

CANADIAN PATENTS

191. Canadian Patent 1,226,816: Folkman, MJ., Taylor, S., Langer, R., Inhibition of Angiogenesis.
192. Canadian Patent 1,274,179: D'Amore, P., Leong, K., Langer, R., Bioerodible Articles Useful as Implants and Prostheses Having Predictable Degradation Rates.
193. Canadian Patent 1,274,339: Domb, A., Langer, R., Synthesis and Application of High Molecular Weight Polyanhydrides
194. Canadian Patent 1,278,141: Domb, A., Langer, R., Preparation of Anhydride Copolymers.
195. Canadian Patent 1,288,673: Hannon, R., Thompson, R., Langer, R., Folkman, J., The Heparinase Assay.
196. Canadian Patent 1,291,064: Langer, R., Kost, J., Ultrasonically Modulated Polymeric Devices for Delivering Drug Compositions.
197. Canadian Patent 1,298,550: Neutralization of the Anticoagulant Activities of Low Molecular Weight Heparin.
198. Canadian Patent 1,315,676: Comfort, A., Heft, R., Langer, R., Heparin Neutralization Using Compounds Immobilized and in Direct Contact with Whole Blood.
199. Canadian Patent 1,323,566: Kohn, J., Langer, R., Niemi, S., Fox, J., Biodegradable Polymeric Drug Delivery System with Adjuvant Activity.
200. Canadian Patent 1,324,051: Kost, J., Langer, R., Ultrasound Enhancement of Transdermal Drug Delivery.
201. Canadian Patent 1,326,268: Weaver, J., Powell, K., Langer, R., Transport of Molecules Across Tissue Using Electroporation.
202. Canadian Patent 1,332,996: Domb, A., Langer, R., Golomb, G., Cravalho, E., Mathiowitz, E., Laurencin, C., Hydroxamic Acid Polymers Formed from Primary Amide Polymers.
203. Canadian Patent 1,335,858: Domb, A., Langer, R., Polyanhydrides with Improved Hydrolytic Degradation Properties.
204. Canadian Patent 1,336,068: Mathiowitz, E., Langer, R., Multiwall, Polymeric, Microcapsules.
205. Canadian Patent 1,336,814: Lees, R., Langer, R., Mullon, C., Conlon, H., Reduction of low-density lipoprotein in biological fluids.
206. Canadian Patent 1,340,581: Vacanti, J., Langer, R., Chimeric Neomorphogenesis of Organs by Controlled Cellular Implantation Using Artificial Matrices.
207. Canadian Patent 2,049,119: Mullon, C., Langer, R., Lees, R., Labeque, R., Lipoprotein Removal by Soluble Enzymes.`
208. Canadian Patent 2,051,663: Vacanti, J., Langer, R., Neomorphogenesis of Cartilage *in vivo* from Cell culture.
209. Canadian Patent 2,056,384: Gerhardt, T., Cato, L., Langer, R., Wilson, H. Bioerodible Polymers for Drug Delivery in Bone.
210. Canadian Patent 2,122,004: Sasisekharan, R., Moremen, K., Cooney, C., Zimmerman, J., Langer, R., Heparinase gene from flavobacterium heparinum.

211. Canadian Patent 2,150,263: Sasisekharan, R., Lohse, D., Cooney, C., Linhardt, R., Langer, R., Wheaton, B., Purification Composition and Specificity of Heparinase I, II, and III from Flavobacterium Heparinum.
212. Canadian Patent 2,207,286: Langer, R., Vacanti, J., Mooney, D., Localized Delivery of Factors Enhancing Survival of Transplanted Cells.
213. Canadian Patent 2,220,180: Langer, R., Berde, C., Prolonged Nerve Blockage by the Combination of Local Anesthetics and Glucocorticoids.

EUROPEAN PATENTS

214. European Patent 0,058,686: AT, CH, DE, FR, GB, LI, LU, NL, SE: Langer, R., Linhardt, R., Cooney, C., Galliher, P., Procedure of Producing of Heparinase.
215. European Patent 0,114,589: AT, BE, CH, Denmark 168876, FR, GB, IT, LI, LU, NL, SE, W. Germany 3373782.7: Folkman, M.J., Taylor, S., Langer, R., Inhibition of Angiogenesis.
216. European Patent 0,245,535: Germany DE 36 85 958.3: Kost, J., Langer, R. Ultrasonically Modulated Polymeric Devices for Delivering Compositions.
217. European Patent 0,246,341: BE, DE, FR, GB, IT, LU, NL, SE: D'Amore, P., Leong, K., Langer, R., Bioerodible Articles Useful as Implants and Prostheses Having Predictable Degradation Rates.
218. European Patent 0,259,463: AT, BE, CH, DE, FR, GB, IT, LI, LU, NL, SE: Folkman, J., Hannan, R., Langer, R., Thompson, R., Heparin Assay.
219. European Patent 0,260,415: AT, BE, CH, DE, ES, FR, GB, GR, IT, LI, LU, NL, SE: Langer, R., Domb, A., Synthesis and Application of High Molecular Weight Polyanhydrides.
220. European Patent 0,275,284: AT, BE, CH, DE, FR, GB, IT, LI, LU, NL, SE: Kost, J., Levy, D. and Langer, R., Ultrasound Enhancer in Transdermal Application.
221. European Patent 0,290,891: Sabel, B., Freese, A., Saltzman, W., Langer, R., Controlled Drug Delivery System for Treatment of Neural Disorders.
222. European Patent 0,299,010: Vacanti, J., Langer, R., Chimeric Neomorphogenesis of Organs by Controlled Cellular Implantation Using Artificial Matrices.
223. European Patent 0,347,424: Domb, A., Langer, R., Cravalho, E., Golomb, G., Mathiowitz, E., Laurencin, C., AT, BE, CH, DE, FR, GB, IT, LI, LU, NL, SE: Hydroxamic Acid Polymers Formed From Primary Amide Polymers.
224. European Patent 0,354,916: AT, BE, CH, DE, FR, GB, IT, LI, LU, NL, SE: Heft, R., Comfort, A., Langer, R., Neutralization of Heparin.
225. European Patent 0,358,677 Mathiowitz, E., Langer, R., Multiwall Polymeric Microcapsules.
226. European Patent 0,368,912: IT, BE, CH, FR, GB, LU, AT-E102833, DE-P3888536, NZ-225323: France: Belgium: Domb, A., Langer, R., Polyanhydrides with Improved Hydrolytic Degradation Properties.
227. European Patent 0,382,772: BE, CH, DE, FR, GB, IT, LI, LU, NL, SE, AT-86498: Lees, R., Langer, R., Mullon, C., Conlon, H.D., Reduction of low-density lipoprotein in biological fluids.
228. European Patent 0,398,960: Weaver, J., Powell, K., Langer, R., Transport of Molecules Across Tissue Using Electroporation.
229. European Patent 0,422,209: AT-E119787, BE, CH, FR, GB, IT, CE-69017820, NL, SE, SP: Vacanti, J., Langer, R., Johnson, L., Griffith-Cima, L., Method for Implanting Large Volumes of Cells on Polymeric Matrices, Sweden: Implantation of cell-matrix structures in the mesentery and momentum.
230. European Patent 0,469,070: Vacanti, J., Vacanti, C. and Langer, R., Neomorphogenesis of Cartilage *in vivo* from Cell Culture.
231. European Patent 0,476,045: Gerhardt, T., Laurencin, C., Domb, A., Langer, R., Hayes, W., Bioerodible polymers for drug delivery in bone.
232. European Patent 0,548,236: BE, DE-69110289T2, DK, FR, GB, GR, IT, SP: Zohar, Y., D'Emanuele, A., Kost, J., Langer, R., Ultrasound-Mediated Administration of Compounds into Aquatic Animals.
233. European Patent 0,551,411: Belgium, Luxembourg, United Kingdom, Switzerland, Austria, Denmark: Cohen, S., Bano, C., Visscher, K., Chow, M., Allcock, H., Langer, R., Ionically Cross- linked Polymeric Microcapsules.
234. European Patent 0,610,408: AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, LI, LU, MC, NL, SE: Sasisekharan, R., Moremen, K., Cooney, C., Zimmerman, J., Langer, R., Heparinase Gene from Flavobacterium Heparinum.
235. European Patent 0,610,423: Stein, J., Gilbert, J., Ingber, D., Langer, R., Vacanti, J., Prevascularized Polymeric Implants for Organ Transplantation.

236. European patent 0,610,423: Vacanti, J., Langer, R., Ingber, D., Mikos, A., Implantation of a matrix which is vacularized and then seeded with cells to form a cell-matrix structure.
237. European Patent 0,619,732: AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LI, LU, MC, NL, PT, SE: Barrera, D., Langer, R., Lansbury, P., Vacanti, J., Biodegradable Polymers for Cell Transplantation.
238. European Patent 0,659,073: AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, LI, LU, MC, NL, PT, SE: Berde, C., Langer, R., Biodegradable Polymer Matrices for Sustainable Delivery of Local Anesthetic Agents.
239. European Patent 0,692,510: AT, BE, CH, DE, ES, FR, GB, GR, IT, LI, LU NL: Domb, A., Langer, R., Preparation of Anhydride Copolymers.
240. European Patent 0,710,261: AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, LI, LU, MC, NL, PT, SE: Gref, R., Minamitake, Y., Langer, R., Biodegradable microparticles and injectable.
241. European Patent 0,712,421: AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, LI, LU, MC, NL, PT, SE: Domb, A., Gref, R., Minamitake, M., Peracchia, MT, Langer, R., Nanoparticles and Microparticles of Nonlinear Hydrophilic-Hydrophobic Multiblock Copolymers.
242. European Patent 0,720,471: AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LI, LU, MC, NL, PT, SE, UK: Adrianov, A., Langer, R., Hydrophobic Polymeric Microcapsules.
243. European Patent 0,781,150: MIT, Enhanced Transdermal Transport Using Ultrasound
244. European Patent 0,794,790: AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LI, LU, MC, NL, PT, SE: Mooney, D., Langer, R., Vacanti, J., Localized Delivery of Factors Enhancing Survival of Transplanted Cells.
245. European Patent 0,882,085: AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LI, LU, MC, NL, PT, SE: Anseth, K., Langer, R., Shastri, V., Biodegradable Polymer Networks for use in Orthopedic and Dental Applications.
246. European Patent 0,907,356: AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LI, LU, MC, NL, PT, SE: Edwards, D., Caponetti, G., Hrkach, J., Lotan, N., Hanes, J., Ben-Jebria, A., Langer, R., Aerodynamically Light Particles for Pulmonary Drug Delivery.
247. European Patent 0,914,092: AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LI, LU, MC, NL, PT, SE: Santini, J., Cima, M., Langer, R., Gopferich, A., Microchip Drug Delivery Devices
248. European Patent 0,915,684: AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LI, LU, MC, NL, PT, SE: Gresser, J., Trantolo, D., Langer, R., Klibanov, A., Wise, D., Vigneaux, S., Material for Buffered Resorbable Internal Devices and Method for Making Same.
249. European Patent: Germany 69028524.8-08: Vacanti, J., Vacanti, C., Langer, R., Neomorphogenesis of Cartilage *in vivo* from Cell Culture.
250. Austria Patent E119787: Johnson, L., Langer, R., Vacanti, J., Method of Implanting Large Cell Volume on a Polymeric Matrix.
251. Austria Patent E139432: Vacanti, J., Langer, R., Chimeric Neomorphogenesis of Organs by Controlled Cellular Implantation Using Artificial Matrices.
252. Austria Patent E142511: Vacanti, J., Vacanti, C., Langer, R., Neomorphogenesis of Cartilage *in vivo* from Cell Culture.
253. German Patent 69017820: Johnson, L., Langer, R., Vacanti, J., Method of Implanting Large Cell Volume on a Polymeric Matrix.
254. German Patent DE69124101: Cohen, S., Bano, C., Visscher, K., Chow, M., Allcock, H., Langer, R., Ionically Cross-linked Polymeric Microcapsules.
255. German Patent P3751843.7: Vacanti, J., Langer, R., Chimeric Neomorphogenesis of Organs by Controlled Cellular Implantation Using Artificial Matrices.
256. German Patent P69028524.8-08: Langer, R., Vacanti, J., Vacanti, C., Neomorphogenesis of Cartilage.
257. European Patent 96915432.7: AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LI, LU, MC, NL, PT, SE: Berde, C., Langer, R., Prolonged Nerve Blockage by the Combination of Local Anesthetics and Glucocorticoids.
258. European Patent 1005378: AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LI, LU, MC, NL, PT, SE: Langer, R., Elisseeff, J., Anseth, K., Sims, D., Semi-Interpenetrating Polymer Networks for Drug Delivery and Tissue Engineering.

JAPANESE PATENTS

259. Japanese Patent 1886595: Vacanti, J., Langer, R., Neomorphogenesis of Cartilage *in vivo* from Cell culture.

260. Japanese Patent 2018881: Langer, R., Kost, J., Ultrasonically Modulated Polymeric Devices for Delivering Drug Compositions.
261. Japanese Patent 2020968: Domb, A., Langer, R., Polyanhydrides with Improved Hydrolytic Degradation Properties.
262. Japanese Patent 2057614: D'Amore, P., Leong, K., Langer, R., Bioerodible Articles Useful as Implants and Prostheses Having Predictable Degradation Rates.
263. Japanese Patent 2067741: Langer, R., Vacanti, J., Controlled Cellular Implantation Using Artificial Matrices.
264. Japanese Patent 3073766: Vacanti, J., Langer, R., Johnson, L., Griffith-Cima, L., Method for implanting large volumes of cells on polymeric matrices.

KOREA PATENTS

265. Korean Patent 970930: Domb, A., Langer, R., Preparation of Anhydride Coploymers.

MEXICAN PATENTS

266. Mexican Patent 185658: Roberts, B., Andrianov, A., Langer, R. Hydrophobic Polymeric Microparticles.

US PATENTS PENDING

267. US Patent: Ameer, G., Rupnick, M., Ploegh, H., Langer, R., Extracorporeal removal of Beta-2-microglobulin, pending.
268. US, Patent 09/803,319: Anderson, D., Putnam, D., Langer, R., Uses and Methods of Making Microarrays of Polymeric Biomaterials, pending.
269. US Patent: Ando, S., Putnam, D., Langer, R. Method for high supercoiled DNA content microspheres, pending.
270. US Patent: Anseth, K., Shastri, V., Langer, R., Biodegradable polymer networks for use in orthopedic and dental applications, pending.
271. US Patent: Atala, A., Mooney, D., Langer, R., Vacanti, J. Breast tissue engineering, pending.
272. US Patent: Atala, A, Vacanti, J., Freeman, M., Langer, R., Neomorphogenesis of Urolgical Structures *in vivo* from Cell Culture, pending.
273. US Patent: Chen, H., Langer, R. Targeted polymerized liposomes for improved drug delivery. pending
274. US Patent: Comfort, A., Heft, R., Langer, R., Extracorporeal Systems for Heparin -Neutralization using Porous Fibers and Tubes, pending.
275. US Patent: Cooney, C., Langer, R., Site-Specific Anticoagulants, pending.
276. US Patent: Domb, A., Mathiowitz, E., Laurencin, C., Karel, M., Langer, R., Polyanhydrides in Food Applications, pending.
277. US Patent: Domb, A., Langer, R., Polyanhydrides with improved hydrolytic degradation properties, pending.
278. US Patent: Edwards, D., Langer, R. Method and materials for enhancing cellular internalization of biotherapeutics, pending.
279. US Patent: Edwards, D., Caponetti, G., Hrkach, J., Lotan, N., Hanes, J., Langer, R., Porous microparticles for pulmonary drug delivery, pending.
280. US Patent: Freese, A, During, M., Kibat, P., Steichen, J., Langer, R., Application of Liposomes Drug Delivery Systems for Neurological & Psychiatric Disorders, pending.
281. US Patent: Galakatos, N., Langer, R., Formulation Array System Technology, pending.
282. US Patent: Galakatos, N., Langer, R., Putnam, D., Sample assays and high-throughput testing thereof to detect interactions, pending.
283. US Patent: Galakatos, N., Langer, R., Putnam, D., Formulation of array system technology, pending.
284. US Patent: Gerhardt, T., Domb, A., Langer, R., Hayes, T., Bioerodible Polyanhydrides for Antibiotic Drug Delivery, pending.
285. US Patent: Gref, R., Minamitake, Y., Langer, R., Biodegradable Microparticles and Injectable Nanoparticles, pending.
286. US Patent: Heft, R., Langer, R., Affinity Purification of Antithrombin III, pending.

287. US Patent: Hirosue, S., Mueller, B., Mulligan, R., Langer, R., Sub 100nm biodegradable polymer spheres capable of transporting and releasing nucleic acids, pending.
288. US Patent: Ingber, D., Langer, R., Wong, J., Control of Cell Function on Electrically Conducting Polymers, pending.
289. US Patent: Kim, H., Hrkach, J., Langer, R., Biodegradable Lubricants, pending.
290. US Patent: Langer, R. and Klibanov, A., Method for screening for drug applications, pending.
291. US Patent: Kost, J., Mitragotri, S., Tate, R., Langer, R., Nelsen, L., Sonophoretic Enhanced Transdermal Transport, pending.
292. US Patent: Labeque, R., Lees, R., Langer, R., Injectable Enzymes for LDL Removal, pending.
293. US Patent: Langer, R., Vacanti, J., Chimeric Neomorphogenesis of Organs by Controlled Cellular Implantation Using Artificial Matrices, pending.
294. US Patent: Langer, R., Klagsburn, M., Brown, L. and Murray, J., Release of Biologically Active Substances, pending.
295. US Patent: Langer, R., Linhardt, R., Cooney, C., Galliher, P., Apparatus for Neutralizing Heparin, pending.
296. US Patent: Langer, R., Mikos, A., Sarakinos, J., Vacanti, J., Polymer Membranes and Methods of Preparation of Three Dimensional Membrane Structures, pending.
297. US Patent: Langer, R., Martin, I., Rahman, N., Shastri, V., Polypyrole Scaffold for bone regeneration, pending.
298. US Patent: Langer, R., Sung, C., Klibanov, A., Lavin, A., Process for Removing Bilirubin from Blood, pending.
299. US Patent: Langer, R., Vacanti, J., Prevascularized Polymeric Implants for Organ Transportation, pending.
300. US Patent: Langer, R., Domb, A., Synthesis and application of high molecular weight polyanhydrides, pending.
301. US Patent: Langer, R., Martin, I. A novel and versatile approach toward the fabrication of porous polymer matrices, pending
302. US Patent: Langer, R., Murray, J., Moses, M., Collagenase Inhibitors, pending.
303. US Patent: Larsen, A., Linhardt, R., Wogan, G., Langer, R., Heparin Fragments Resistant to Biotransformation, pending.
304. US Patent: Laurencin, C., Lucas, P., Domb, A., Langer, R., Bioerodible Polymeric Delivery Systems for Induction of Cartilage and Bone, pending.
305. US Patent: Laurencin, C., Langer, R., Allcock, H., Neenan, T., Polyphosphazene Matrix System for Drug Delivery Applications, pending.
306. US Patent: Lynn, D., Putnam, D., Amiji, M., Langer, R., Biodegradable poly(bets-amino esters) and uses thereof, pending.
307. US Patent: Mathiowitz E., Langer, R., Mullon, C., Domb, A., Preparation of Polyanhydride Microspheres and Use in Controlled Drug Delivery, pending.
308. US Patent: Mathiowitz, E., Langer, R., Multiwall Polymeric Microcapsules, pending.
309. US Patent: Mathiowitz, E., Langer, R., Warshawsky, A., Edelman, E., Polymer composite for controlled release or membrane formation, pending.
310. US Patent: Mathiowitz, E., Peppas, N., Langer, R. Bioadhesive Properties of Polyanhydrides Suitable for Oral Delivery Systems, pending.
311. US Patent: Mikos, A., Langer, R., Preparation of Biodegradable Non-Woven Fiber Structures by Heat Treatment of Polymer Composites, pending.
312. US Patent: Mikos, A., Ingber, D., Vacanti, J., Langer, R., A Chemical Method to make Porous Structures which could be seeded with cells for implantation, pending.
313. US Patent: Mitragotri, S., Blankschtein, D., Langer, R., Transdermal protein delivery using low frequency sonophoresis. Pending.
314. US Patent: Mooney, D., Schwendeman, S., Sano, K., Langer, R., Vacanti, J., Kaufmann, P., Localized Delivery of Factors Enhancing Survival of Transplanted Cells, pending.
315. US Patent: Moses, M. Sudhalter, J., Langer, R., Method and Composition for Inhibition of Angiogenesis, pending.
316. US Patent: Mullon, C., Klibanov, A., Langer, R., Method for Measuring Unbound Bilirubin in Serum of Plasma, pending.
317. US Patent: Mullon, C., Lees, R., Langer, R., Conlon, H., Reduction of Low Density Lipoproteins in Biological Fluids, pending.
318. US Patent: Niklason, L.E., Gao, J, Langer, R. Tissue engineered constructs, pending.

319. US Patent: Okada, J., Cohen, S., Langer, R., Specification of polymerized liposomes with enhanced stability, pending.
320. US Patent: Organ, G., Vacanti, J., Langer, R., Neomorphogenesis of intestine in vivo from cell cultures, pending.
321. US Patent: Prausnitz, M., Cullander, C., Weaver, J., Guy, R., Langer, R., Process for delivery of particles into tissue, pending.
322. US Patent: Prausnitz, M., Edwards, D., Langer, R., Transdermal molecular transport by an oscillatory mechanism, pending.
323. US Patent: Prausnitz, M., Gimm, J., Langer, R., Weaver, J., Targeted delivery of drugs to hair follicles, pending.
324. US Patent: Putnam, D., Langer, R., Endosomolytic polymers for high efficiency gene transfer, pending.
325. US Patent: Richards, A., Santini, J., Cima, M., Langer, R., Microchip devices for delivery of molecules and methods of fabrication thereof, pending.
326. US Patent: Sabel, B., Buccalo, L., Langer, R., Polymeric Device for Controlled Drug Delivery to the CNS, pending.
327. US Patent: Santini, J. Jr., Cima, M., Langer, R., Miniaturized Multi-Welled Drug Delivery Device, pending.
328. US Patent: Santini, J., Richards, A., Scheidt, R., Cima, M., Langer R., Microchips as controlled drug delivery devices, pending.
329. US Patent: Santini, J., Cima, M., Langer, R., Goepferich, A., Microchip drug delivery devices, pending.
330. US Patent: Shastri, P., Martin, I., Langer, R., A novel and versatile approach toward the fabrication of porous polymer matrices, pending.
331. US Patent: Shastri, V., Martin, I., Langer, R., Method for preparing three-dimensional polymer foams, pending.
332. US Patent: Shastri, V., Langer, R., MRI Contrast Agent, pending.
333. US Patent: Shastri, V., Santini, J., Langer, R., Drug Delivery Devices, pending.
334. US Patent: Shastri, V., Schmidt, C., Langer, R., Vacanti, J., Neuronal stimulation using electrically conducting polymers, pending.
335. US Patent MIT case # 9365: Shastri, V., Zelikin, A., Lynn, D., Martin, I., Langer, R., Bioerodible Conducting Polymers, Pending.
336. US Patent, MIT Case 8783: Shastri, V., Yang, C-C. and Langer, R., Microsphere Delivery System, pending.
337. US Patent: Shefer, S., Afeyan, N., Langer R., Quantitative Measurement of LDL, pending.
338. US Patent: Vacanti, C., Vacanti, J., Langer, R., Neomorphogenesis of Bone *In Vivo* From Cell Culture, pending.
339. US Patent: Vacanti, C., Lipton, J., Paige, K., Vacanti, J., Langer, T., Cao, Y. Lin, Neomorphogenesis of Tendons in vivo from Cell Culture, pending.
340. US Patent: Vacanti, J., Langer, R., Chimeric Neomorphogenesis of Urological Structures by Controlled Cellular Implantation using Artificial Matrices, accepted.
341. US Patent: Vacanti, J., Langer, R., Controlled cellular implantation using artificial matrices, pending.
342. US Patent: Vacanti, J., Langer, R., Neomorphogenis of Urological Structures in vivo from Cell Cultures, pending
343. US Patent: Vacanti, J., Langer, R., Neomorphogenesis of Cartilage *in vivo* from Cell Culture, pending.
344. US Patent: Vacanti, J., Langer, R., Johnson, L., Cima, L.G., Method for implanting large volumes of cells on polymeric matrices, pending.
345. US Patent. Vacanti, J., Langer, R., Vacanti, C., Biodegradable Synthetic Polymeric Fibrous Matrix Containing Chondrocyte for in vivo Production of a Cartilaginous Structure, pending.
346. US Patent: Vacanti, J. Langer, R, Chimeric Neomorphogenesis of Organs by Controlled Cellular Implantation Using Artificial Matrices, pending.
347. US Patent: Vacanti, J., Langer, R., Atala, A., Mooney, D., Neomorphogenesis of breast tissue as replacement for cosmetic surgery of the breast or reconstructive surgery of the breast, pending
348. US Patent: Vacanti, J., Langer, R., Ingber, D., Mikos, A., Implantation of a matrix which is vacularized and then seeded with cells to form a cell-matrix structure, pending.
349. US Patent: Vacanti, J., Langer, R., Implantation of cell-matrix structures in the mesentary and momentum, pending.
350. US Patent: Venkataraman, G., Ernst, S., Cooney, C., Godavarti, R., Langer, R. Rationally designed polysaccharide lyases derived from Heparinase I, pending.
351. US Patent: Wong, J., Ingber, D., Langer, R., Control of Cell Function on Electrically Conducting Polymers, pending.
352. US Patent: Yang, V., Bernstein, H., Langer, R., Neutralizaton of the Anticoagulation Activities of the Low Molecular Weight Heparin Fragments and Fragments with Flavobacterial Heparinase, pending.

353. US Patent: Zewert, T., Pliquett, U., Langer R., Weaver, J. Delivery of nucleotides into organisms by electroporation, pending.
354. US Patent: Santini, Sheppard, N., Langer, R., Young, C.C., Microfabricated Devices for the Selective Exposure of Sensor or Reaction Components, pending.
355. US Patent: No. 17509-0016: Santini, J., Cima, M., Langer, R., Ausiello D. Microchip Devices for Ophthalmic Applications, pending.
356. US Patent: MIT No. 9015: Vunjak-Novakovic, G., Langer, R., Madry, H., Trippel, S. Tissue Engineering of Cartilage Enhanced By the Transfer of Human Insulin-Like Growth Factor-I-Gene, pending.
357. US Patent: MIT No. 8749: Langer, R., Papadaki, M., van Blitterswijk, C., Riesle, J., Muscle Tissue Engineering, pending.
358. US Patent: MIT No. 9082: Langer, R. Macrochemotherapeutics- A New Concept In the Design of Anti-Neoplastic Agents, pending.
359. US Patent: MIT No. 9093: Langer, R. Improvement of Biological Activity of Bioactive Agents By Complexation With Cyclodextrin, pending.
360. US Patent: Langer, R. Bioengineered Anterior Cruciate Ligament, pending.
361. US Patent: 09/685, 232: Langer, R., Ameer, G. Cell Delivery Using Controllable Degradable Mesh-Gel Constructs.
362. US Patent: 60/186,545: Santini, J., Sheppard, N., Young, C. C. Microfabricated Devices for the Storage and Selective of Chemicals and Devices, pending.
363. US Patent: Kohane, D., LaVan, D., Langer, R. In vivo sensor package incorporated into a replacement cardiac valve or repair ring (natural, synthetic, or tissue engineered), pending.
364. US Patent: MIT Case No. 9042. Langer, R., Lynn, D., Putnam, D., Amiji, M. Biodegradable Poly(Beta-Amino Esters) and uses, pending.
365. US Patent: MIT Case No. 9188. Langer, R. Porous Self-Assembly Monolayers, pending.
366. US Patent Lynn, D., Vasquez, E., Langer, R., Hammond, P., Methods of Making Decomposable Thin Films of Polyelectrolytes and Uses Thereof, pending
367. US Patent 17509-0024 Santini, J., Cima, M.J., Langer, R., Ausiello, D., Sheppard, N., Herman, S.J., Flexible microchip devices for ophthalmic and other applications, pending
368. US Patent: MIT Case No. 9652. Mitragotri, S., Langer, R. Mechanism to Enhance Transdermal Drug Delivery, pending
369. US Patent: MIT Case No. 9641. Putnam, D., Langer, R. Phagosomolytic Microparticles for Targetable Cytoolic DNA to Antigen Presenting Cells, Pending
370. US Patent MIT Case No. 8151. Putnam, D., Langer, R. Endosomolytic agents and Cell Delivery, pending
371. US Patent: Kohane, D., Langer, R., Prolonged suppression of electrical activity in excitable tissue. Pending.
372. US Patent: Levenberg, S., Michal, A., Itskovitz-Elder, J., Langer, R., Endothelial Cells Derived from Human Embryonic Stems Cells, pending.
373. US Patent: Marletta, M., Langer, R., NO Releasing or Generating Materials for Treatment of Pulmonary Disorders, pending
374. US Patent 60/419,722: Westphal, C., Langer, R., Therapeutic Compositions, pending
375. US Patent: MIT Case No. 9991. Chau, Y., Langer, R., Polymer-Linker-Drug Conjugates for Targeted Drug Delivery, pending
376. US Patent: Hutchinson, C., Langer, R, Garner, B., and Warren, J. Shape memory expandable needles, pending
377. US Patent: Lahann, J., Mitragotri, S., Langer, R., Switchable Surfaces, pending
378. US Patent: Farokhzad, O., LaVan, D., Jon, S.Y., Tran, T., Langer, R., Method and uses of electrical biosensor devices comprising of aptomer conjugated electrical sensors, pending
379. US Patent: Levenberg, S., Huang, N.F., Lavik, E., Itskovitz-Eldor, J., Langer, R., Engineering 3 dimensional tissue structures using human embryonic stem cells, pending.
380. US Patent: Kohane, D. and Langer, R., Formulations for orialnasal, gastrointestinal and topic drug delivery, pending.
381. US Patent: Kohane, D. and Langer, R., Methods of prevention and treatment of suglottic stenosis, pending.
382. US Patent: Kohane, D. and Langer, R., Prophylaxis of fungal infections, pending.
383. U.S. Patent: Radisic, M., Park, H., Langer, R., Freed, L. and Vunjak-Novakovic, G., In vitro application of electrical stimulation for functional tissue engineering, pending.

384. U.S. Patent: Johnson, A., Cima, M. and Langer, R., Microscale lyophilization and drying methods for the stabilization of molecules, pending.
385. U.S. Patent 09/981,020: Kohane, D., Lipp, M. and Langer, R., Lipid protein sugar particles for drug delivery, pending.
386. U.S. Patent: Little, S., Lynn, D., Anderson, D. and Langer, R. pH sensitive, microsphere based, vaccine delivery using poly(β-amino ester)s, pending.
387. U.S. Patent: Farokhzad, O., Jon, S. and Langer, R., Targeted delivery of nano- or microparticles using nucleic acid ligands, pending
388. U.S. Patent: Baroli, B., Shastri, V.P. and Langer, R., A method to protect sensitive molecules from a photopolymerizing environment, pending.
389. U.S. Patent: Lendlein, A. and Langer, R., Self-expanding device for the gastrointestinal or urogential area, pending.
390. U.S. Patent: Langer, R., Tissue engineered tubular construct having circumferentially oriented smooth muscle cells, pending.
391. U.S. Patent, MIT Case 10227: Wang, C. and Langer, R., Formation of dynamic nanostructures and nanodevices driven by protein self-assembly, pending.
392. U.S. Patent, MIT Case 10228: Wang, C. and Langer, R., Facile synthesis of nanostructure-hydrogel composites, pending.
393. U.S. Patent, MIT Case 9841: Anderson, D. and Langer, R., Parallel synthesis and testing of arrayed polymers, pending.
394. U.S. Patent, MIT Case 9947: Lynn, D. and Langer, R., Degradable conducting materials, pending.
395. U.S. Patent, MIT Case 9487: Lynn, D., Vazquez, E., Hammond, P., and Langer, R., Assembly of degradable thin films via layer-by-layer deposition of degradable polyelectrolytes, pending.
396. U.S. Patent: Farokhzad, O., Jon, S.Y. and Langer, R., Targeted delivery of controlled release polymer systems, pending.
397. U.S. Patent, MIT Case 9022: Anderson, D., Kohane, D. and Langer, R., Methods for the pH-triggered release of compounds from micro- and nanospheres, pending.
398. U.S. Patent, MIT Case 8851: Lahann, J., Chau, Y., and Langer, R., Site-specific drug delivery using drug vehicles with micro-gates, pending.
399. U.S. Patent, MIT Case 10317: Farokhzad, Omid and Langer, R., Isolation of disease specific nucleic acid ligands and purification of targets by affinity chromatography, pending.
400. U.S. Patent, MGH Case 60466318: Ron, E.S. and Langer, R., Intravaginal drug delivery device, pending.
401. U.S. Patent 60452891: George, P., Langer, R., LaVan, D., Methods and uses for simple three-dimensional microfabrication, pending.
402. U.S. Patent 60473579, Ron, E. and Langer, R., Methods for contraception and treatment of female reproductive conditions and disorders, pending.
403. US Patent, MIT Case 10172: Anderson, D., Lynn, D., Akinc, A. and Langer, R., Biodegradable poly(beta-amino esters) and uses thereof, pending.
404. US Patent, MIT Case 10180: Kohane, D., Anderson, D., Langer, R., Haining, W., Nadler, L., ph-triggered microparticles, pending.
405. US Patent, MIT Case 10477: Anderson, D., Levenberg, S. and Langer, R., Nanoliter-scale synthesis of arrayed biomaterials and screening with human embryonic stem cells, pending.
406. US Patent, MIT Case 10647: Berry, D., Anderson, D., Lynn, D. and Langer, R., Intercellular delivery of heparin-like compounds, pending.
407. US Patent: Berry, D., Anderson, D., Lynn, D., Sasisekharan, R. and Langer, R. Methods and products related to the intracellular delivery of polysaccharides, pending.

AUSTRALIAN PATENTS PENDING

408. Australian Patent: Berde, C., Langer, R., Biodegradable polymer matrices for sustained delivery of local anesthetic agents, pending.
409. Australian Patent: Folkman, M., Taylor, S., Langer, R., Inhibition of Angiogenesis, pending.
410. Australian Patent 751861: Lendlien, A., Schmidt, A., Grablowitz, H., Langer, R., Biodegradable shape memory, polymers, pending.

411. Australian Patent: Vacanti, J., Langer, R., Vacanti, C., Construction of cell-matrix structures for implantation to create connective tissues such as cartilage or bone, pending.

CANADIAN PATENTS PENDING

412. Canadian Patent: Barrera, D., Langer, R., Lansbury, P., Vacanti, J., Biodegradable Polymers for Cell Transplantation. Pending
413. Canadian Patent: Berde, C., Langer, R., Biodegradable Polymer Matrices for Sustained Delivery of Local Anesthetic Agents, pending.
414. Canadian Patent: Cohen, S., Bano, C., Visscher, K., Chow, M., Allcock, H., Langer, R., Ionically Cross-linked Polymeric Microcapsules, pending.
415. Canadian Patent: Curley, J., Hedley, ML., Langer, R., Microparticles for Delivery of Nucleic Acid. Pending.
416. Canadian Patent: Domb, A., Langer, R., Golomb, G., Mathiowitz, E., Laurencin, C., Hydroxamic Acid Polymers Formed from Primary Amide Polymers, pending.
417. Canadian Patent: Domb, A., Gref, R., Minamitake, Y., Peracchia, M., Langer, R., Nanoparticles and Microparticles of Non-Linear Hydrophilic-Hydrophobic Multiblock Copolymers, pending.
418. Canadian Patent: Folkman, M., Taylor, S., Langer, R., Inhibition of Angiogenesis, pending.
419. Canadian Patent: Gerhart, T., Laurencin, C., Domb, A., Langer, R., Hayes, W., Bioerodible Polymers for Drug Delivery in Bone. Pending.
420. Canadian Patent: Gopferich, A., Santini, J., Langer, R., Cima, M., Microchip Drug Delivery Devices. Pending.
421. Canadian Patent: Gref, R., Minamitake, Y., Langer, R., Biodegradable Particles, pending.
422. Canadian Patent: Kost, J., Mitragotri, S., Langer, R., Sonophoretic Enhanced Transdermal Transport. Pending.
423. Canadian Patent: Langer, R., Andrianov, A., Hydrophobic Polymeric Microparticles. Pending
424. Canadian Patent: Langer, R., Kost, J., Pishko, M., Pliquett, U., Mitragotri, S., Weaver, J., Blankschtein, D., Johnson, M., Enhanced Transdermal Transport Using Ultrasound. Pending.
425. Canadian Patent: Langer, R., Lees, R., Labeque, R., Mullon, C., Lipoprotein Removal by Soluble Enzymes, pending.
426. Canadian Patent: Langer, R., Murray, J., Moses, M., Collagenase Inhibitors, pending.
427. Canadian Patent: Langer, R., Schmidt, A., Grablowitz, H., Lendlein, A., Biodegradable Shape Memory Polymers. Pending.
428. Canadian Patent: Langer, R., Vacanti, J., Prevascularized Polymeric Implants for Organ Transportation, pending.
429. Canadian Patent: Laurencin, C., Gerhardt, T., Domb, A., Langer, R., Hayes, W., Bioerodible polymers for drug delivery in bone, pending.
430. Canadian Patent: Lees, R., Langer, R., Labeque, R., Mullon, C., Lipoprotein Removal by Soluble Enzymes. Pending.
431. Canadian Patent: Lendlein, A., Langer, R., Shape Memory Polymers. Pending.
432. Canadian Patent: Niklason, L., Gao, J., Langer, R., Tissue-Engineered Constructs. Pending
433. Canadian Patent: Rosenberg, R., Simons, M., Edelman, E., Langer, R., Dekeyser, JL., Localized Oligonucleotide Therapy, pending.
434. Canadian Patent: Rupnick, M., Folkman, J., Langer, R., Method for Regulating Size and Growth of Vascularized Normal Tissue, Pending.
435. Canadian Patent: Sasisekharan, R., Ernst, S., Venkataraman, G., Cooney, C., Langer, R., Godavarti, R., Rationally Designed Polysaccharide Lyases Derived from Heparinase I. Pending.
436. European Patent 0726773A: Sasisekharan, R., Moses, M., Nugent, M., Cooney, C., Langer, R., Method for Inhibiting Angiogenesis Using Heparinase.
437. Canadian Patent: Sasisekharan, R., Lohse, D., Cooney, C., Linhardt, R., Langer, R., Purification, Composition and Specificity of Heparinase I, II and III from Flavobacterium Heparinum, pending.
438. Canadian Patent: Shakesheff, K., Patel, N., Cannizzaro, S., Langer, R., Surface Coating in Spatially Controlled Patterns. Pending.
439. Canadian Patent: Shastri, P., Langer, R., Anseth, K., Biodegradable Polymer Networks for Use in Orthopedic and Dental Applications. Pending.
440. Canadian Patent: Shastri, V., Schmidt, C., Vacanti, J., Langer, R., Neuronal Stimulation Using Electrically Conducting Polymers. Pending.

441. Canadian Patent: Trantolo, D., Gresser, J., Wise, D., Klibanov, A., Langer, R., Lewandroski, K., Resorbable Interbody Spinal Fusion Devices. Pending.
442. Canadian Patent: Vacanti, J., Barrera, D., Lansbury, P., Langer, R., Biodegradable Polymers for Cell Transplantation, pending.
443. Canadian Patent: Vacanti, R., Langer, R., Chimeric Neomorpogenesis of Organs by Controlled Cellular Implantation Using Artificial Matrices, Pending.
444. Canadian Patent: Vacanti, J., Langer, R., Ingber, D., Mikos, A., Implantation of a matrix which is vacularized and then seeded with cells to form a cell-matrix structure, pending.
445. Canadian Patent: Vacanti, J., Langer, R., Johnson, L., Griffith-Cima, L., Method for Implanting Large Volumes of Cells on Polymeric Matrices. Pending.
446. Canadian Patent: Vacanti, J., Langer, R., Vacanti, C., Construction of cell-matrix structures for implantation to create connective tissues such as cartilage or bone, pending.
447. Canadian Patent: Vacanti, J., Mooney, D., Langer, R., Atala, A., Breast Tissue Engineering. Pending.
448. Canadian Patent: Vacanti, J., Vacanti, C., Langer, R., Neomorphogenesis of Cartilage *in vivo* from Cell Culture, pending.
449. Canadian Patent: Wise, D., Klibanov, A., Langer, R., Gresser, R., Trantolo, D., Material for Buffered Resorbable Internal Fixation Devices and Method for Making Same. Pending.
450. Canadian Patent: Wu, I., Sytkowski, A., Wiederschain, D., Moses, M., Langer, R., Troponin Subunits and Fragments Useful as Angiogenesis Inhibitors. Pending.
451. Canadian Patent: Zohar, Y., D'Emanuele, A., Kost, J., Langer, R., Ultrasound-Mediated Administration of Compounds into Aquatic Animals, pending.

EUROPEAN PATENTS PENDING

452. European Patent: Ameer, G., Langer, R. Transdermal Thermal Polymerization, pending.
453. European Patent: Atala, A., Vacanti, J., Freeman, M., Langer, R., Neomorphogenesis of Urolgical Structures *in vivo* from Cell Culture, pending.
454. European Patent: Berde, C., Langer, R., Biodegradable Polymer Matrices for Sustained Delivery of Local Anesthetic Agents, pending.
455. European Patent 0,963,202A: AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LI, LU, MC, NL, PT, SE: Berde, C., Langer, R., Curely, J., Castillo, J., Formulations and Methods for Providing Prolonged Local Anesthesia. Pending
456. European Patent 0,774,964A: AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LI, LU, MC, NL, PT, SE: Brem, H., Langer, R., Domb, A., Controlled Local Delivery of Chemotherapey Agents for Treating Solid Tumors. Pending
457. European Patent: Cohen, S., Bano, C., Visscher, K., Chow, M., Allcock, H., Langer, R., Ionically Crosslinked Polymeric Microcapsules, pending.
458. European Patent 0,266,603A: AT, BE, CH, DE, ES, FR, GB, GR, IT, LI, LU, NL, SE: Domb, A., Langer, R., Preparation of Anhydride Copolymers. Pending
459. European Patent 0,885,002A: AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LI, LU, MC, NL, PT, SE: Edwards, D., Deaver, D., Langer, R., Materials and Methods for Enhancing Cellular Internatization. Pending
460. European Patent 0,954,282A: AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LI, LU, MC, NL, PT, SE: Edwards, D., Hanes, J., Evora, C., Langer, R., Vanbever, R., Mintzes, J., Wang, J., Chen, D., Preparation of Particles for Inhalation. Pending
461. European Patent 1,112,348A: AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LI, LU, MC, NL, PT, SE: Freed, L., Martin, I., Langer, R., Vunjak-Novakovic, G., Use of Growth Factors and Hormones for Expansion of Mammalian Cells and Tissue Engineering. Pending
462. European Patent 1,171,231A: AL, AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LI, LU, MC, MK, NL, PT, RO, SE, SI: Galakatos, N., Langer, R., Putnam, D., Formulation Arrays and Use Thereof. Pending
463. European Patent 1,119,316A: CA, EP, JP: Gresser, J., Trantolo, D., Langer, R., Klibanov, A., Wise, D., Buffered Resorbable Internal Fixation Devices and Methods for Making Material Therefore. Pending
464. European Patent 1,011,545A: CH, DE, ES, FR, GB, IT, LI: Gresser, J., Trantolo, D., Langer, R., Lewandroski, KU., Klibanov, A., Wise, D., Resorbable Interbody Spinal Fusion Devices. Pending.

465. European Patent 1,005,374A: AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LI, LU, MC, NL, PT, SE: Hedley, ML., Curley, J., Langer, R., Lunsford, L., Microparticles for Delivery of Nucleic Acid. Pending.
466. European Patent: Johnson, M., Pishko, M., Mitragotri, S., Blankschtein, D., Langer, R., Kost, J., Pliquett, U., Rowe, S., Enhanced Transdermal Transfer Using Ultrasound. Pending.
467. European Patent 0,471,549A: CH, DE, DK, FR, GB, IT, LI, NL, SE: Lees, R., Langer, R., Labeque, R., Mullon, C., Lipoprotein Removal by Soluble Enzymes. Pending.
468. European Patent 1,056,487A: AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LI, LU, MC, NL, PT, SE: Langer, R., Lendlein, A., Schmidt, A., Grablowitz, H., Biodegradable Shape Memory Polymers. Pending.
469. European Patent: Mikos, A., Ingber, D., Vacanti, J., Langer, R., A Chemical Method to make Porous Structures which could be seeded with cells for implantation. Pending.
470. European Patent 1,045,714A: AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LI, LU, MC, PT, SE: Mitragotri, S., Langer, R., Kost, J., Sonophoretic Enhanced Transdermal Transport. Pending
471. European Patent 0,781,150A: AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LI, LU, MC, NL, PT, SE: Mitragotri, S., Pliquett, U., Johnson, M., Pishko, M., Kost, J., Langer, R., Weaver, J., Blankschtein, D., Enhanced Transdermal Transport Using Ultrasound. Pending
472. European Patent: Mooney, D., Schwendeman, S., Sano, K., Langer, R., Vacanti, J., Kaufmann, P., Localized Delivery of Factors Enhancing Survival of Transplanted Cells. Pending.
473. European Patent 1,007,556A: AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LI, LU, MC, NL, PT, SE: Moses, M., Langer, R., Wiederschain, D., Wu, I., Sytkowski, A., Troponin Subunits and Fragments useful as Angiogenesis Inhibitors. Pending
474. European Patent 1,024,80A1: AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LI, LU, MC, NL, PT, SE: Rupnick, M., Langer, R., Folkman, J., Method for Regulating, Size and Growth of Vascularized Normal Tissue. Pending.
475. European Patent 0,558,697A: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, MC, NL, SE: Rosenberg, R., Simons, M., Edelman, E., Langer, R., Dekeyser, JL., Localized Oligonucleotide Therapy. Pending.
476. European Patent 0,670,892A: AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LI, LU, MC, NL, PT, SE: Sasisekharan, R., Lohse, D., Cooney, C., Linhardt, R., Langer, R., Purification, Composition and Specification of Heparinase I, II, and III; from Flavobacterium Heparinum. Pending.
477. European Patent: Sasisekharan, R., Nugent, M., Cooney, C., Moses, M., Langer, R., Method for Inhibiting Angiogenesis Using Heparinase. Pending.
478. European Patent: Sasisekharan, R., Cooney, C., Langer, R., Heparinase gene from flavobacterium heparinum.
479. European Patent: Shakesheff, K., Langer, R., Patterning Technique. Pending.
480. European Patent 1,049,493A: AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LI, LU, MC, NL, PT, SE: Shakesheff, K., Patel, N., Cannizzaro, S., Langer, R., Surface Coating in Spatially Controlled Patterns. Pending
481. European Patent 0,868,508A: AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LI, LU, MC, NL, PT, SE: Shastri, V, Schmidt, C., Langer, R., Vacanti, J., Neuronal Stimulation Using Electrically Conducting Polymers. Pending.
482. European Patent 0,797,460A: AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LI, LU, MC, NL, PT, SE: Vacanti, J., Atala, A., Mooney, D., Langer, R., Breast Tissue Engineering. Pending.
483. European Patent: Vacanti, J., Langer, R., Neomorphogenesis of Cartilage *in vivo* from Cell culture. Pending.
484. European Patent: Vacanti, J., Langer, R., Vacanti, C., Construction of cell-matrix structures for implantation to create connective tissues such as cartilage or bone. Pending.
485. UK Patent Application Number 9801061.4: Shakesheff, K., Langer, R., Patterning technique. Pending.
486. European Patent 1,163,017A: AL, AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LI, LU, MC, MK, NL, PT, RO, SE, SI: Riesle, JU., Van Blitterswijk, CA., Papadaki, M., Langer, R., Muscle Tissue Engineering. Pending.
487. European Patent 0,663,073A: CH, DE, ES, FR, GB, IT, LI, SE: Varady, L., Afeyan, N., Langer, R., Schefer, S., Quantitive Measurement of LDL. Pending.
488. European Patent 0,199,362A: CH, DE, FR, GB, IT, LI, NL: Wheatley, M., Langer, R., Eisen, H., System and Apparatus for Delayed and Pulsed Release of Biologically Active Substances. Pending.
489. European Patent 98967012.0, Method of regulating size and growth of vascularized normal tissue, Rupnick, M., Yoakim-Turk, M., Langer, R.S., Folkman, J., Jamas, S., pending.
490. European Patent 98934431.2: Shastri, V., Tarcha, P., Langer, R. Semi-interpenetrating polymer networks, pending.

JAPANESE PATENTS PENDING

491. Japanese Patent: Berde, C., Langer, R., Biodegradable Polymer Matrices for Sustained Delivery of Local Anesthetic Agents, pending.
492. Japanese Patent: Cohen, S., Bano, C., Visscher, K., Chow, M., Allcock, H., Langer, R., Ionically Crosslinked Polymeric Microcapsules, pending.
493. Japanese Patent: Domb, A., Langer, R., Golomb, G., Mathiowitz, E., Laurencin, C., Hydroxamic Acid Polymers Formed From Primary Amide Polymers, pending.
494. Japanese Patent: Gref, R., Minamitake, Y., Langer, R., Biodegradable Particles, pending.
495. Japanese Patent: Hannon, R., Thompson, R., Langer, R., Folkman, J., The Heparinase Assay, pending.
496. Japanese Patent: Kost, J., Langer, R., Rowe, S. Ultrasound enhancement of transdermal drug, pending.
497. Japanese Patent: Langer, R., Vacanti, J., Chimeric Neomorphogenesis of Organs by Controlled Cellular Implantation Using Artificial Matrices, pending.
498. Japanese Patent: Langer, R., Murray, J., Moses, M., Collagenase Inhibitors, pending.
499. Japanese Patent: Langer, R., Lees, R., Labeque, R., and Mullon, C., Lipoprotein Removal by Soluble Enzymes, pending.
500. Japanese Patent: Langer, R., Vacanti, J., Prevascularized Polymeric Implants for Organ Transportation, pending.
501. Japanese Patent: Laurencin, C., Gerhardt, T., Domb, A., Langer, R. Hayes, W., Bioerodible polymers for drug delivery in bone, pending.
502. Japanese Patent: Lees, R., Langer, R., Mullon, C., Conlon, H., Reduction of low-density lipoprotein in biological fluids, pending.
503. Japanese Patent: Rosenberg, R., Simons, M., DeKeyser, J-l, Edelman, E., Langer, R., Localized Oligonucleotide Therapy, pending.
504. Japanese Patent: Sasisekharan, R., Moremen, K., Cooney, C., Zimmerman, J., Langer, R., Heparinase Gene From Flavobacterium Heparinum, pending.
505. Japanese Patent: Sasisekharan, R., Nugent, M., Cooney, C., Moses, M., Langer, R., Method for Inhibiting Angiogenesis Using Heparinase, pending.
506. Japanese Patent: Sasisekharan, R., Lohse, D., Cooney, C., Linhardt, R., Langer, R., Purification, Composition and Specificity of Heparinase I, II and III from Flavobacterium Heparinum, pending.
507. Japanese Patent: Vacanti, J., Barrera, D., Lansbury, P., Langer, R., Biodegradable Polymers for Cell Transplantation, pending.
508. Japanese Patent: Vacanti, J., Langer, R., Vacanti, C., Construction of cell-matrix structures for implantation to create connective tissues such as cartilage or bone, pending.
509. Japanese Patent: Vacanti, J., Langer, R., Method for Implanting Large Volumes of Cells on Polymeric Matrices, pending.
510. Japanese Patent: Vacanti, J., Langer, R., Chimeric Neomorphogenesis of Organs by Controlled Cellular Implantation using Artificial Matrices, pending.
511. Japanese Patent: Vacanti, J., Langer, R., Ingber, D., Mikos, A., Implantation of a matrix which is vacularized and then seeded with cells to form a cell-matrix structure, pending.
512. Japanese Patent: Vacanti, J., Langer, R., Implantation of cell-matrix structures in the mesentary and momentum, pending.
513. Japanese Patent: Weaver, J., Powell, K., Langer, R., Transport of molecules across tissue using electroporation, pending.
514. Japanese Patent: Zohar, Y., Langer, R., Ultrasound-Mediated Administration of Compounds into Aquatic Animals, pending.
515. Japanese Patent: Lendlein, A., Langer, R., Shape Memory Polymers, pending.

ISRAELI PATENTS PENDING

516. Israeli Patent: Langer, R., Shape Memory Polymers, pending.

CZECH REPUBLIC PATENTS PENDING

517. Czech Republic Patent: Langer, R., Shape Memory Polymers, pending.

POLISH PATENTS PENDING

518. Polish Patent: Langer, R., Shape Memory Polymers, pending.

TURKISH PATENTS PENDING

519. Turkish Patent: Langer, R., Shape Memory Polymers, pending.

KOREAN PATENTS PENDING

520. S. Korean patent: 2000-7007978, Lendlein, A. and Langer, R., Biodegradable Shape Memory Polyers, pending.

MEXICAN PATENTS PENDING

521. Mexican Patent 975079: Roberts, B., Andrianov, A., Langer, R. Hydrophobic Polymeric Microparticles, pending.